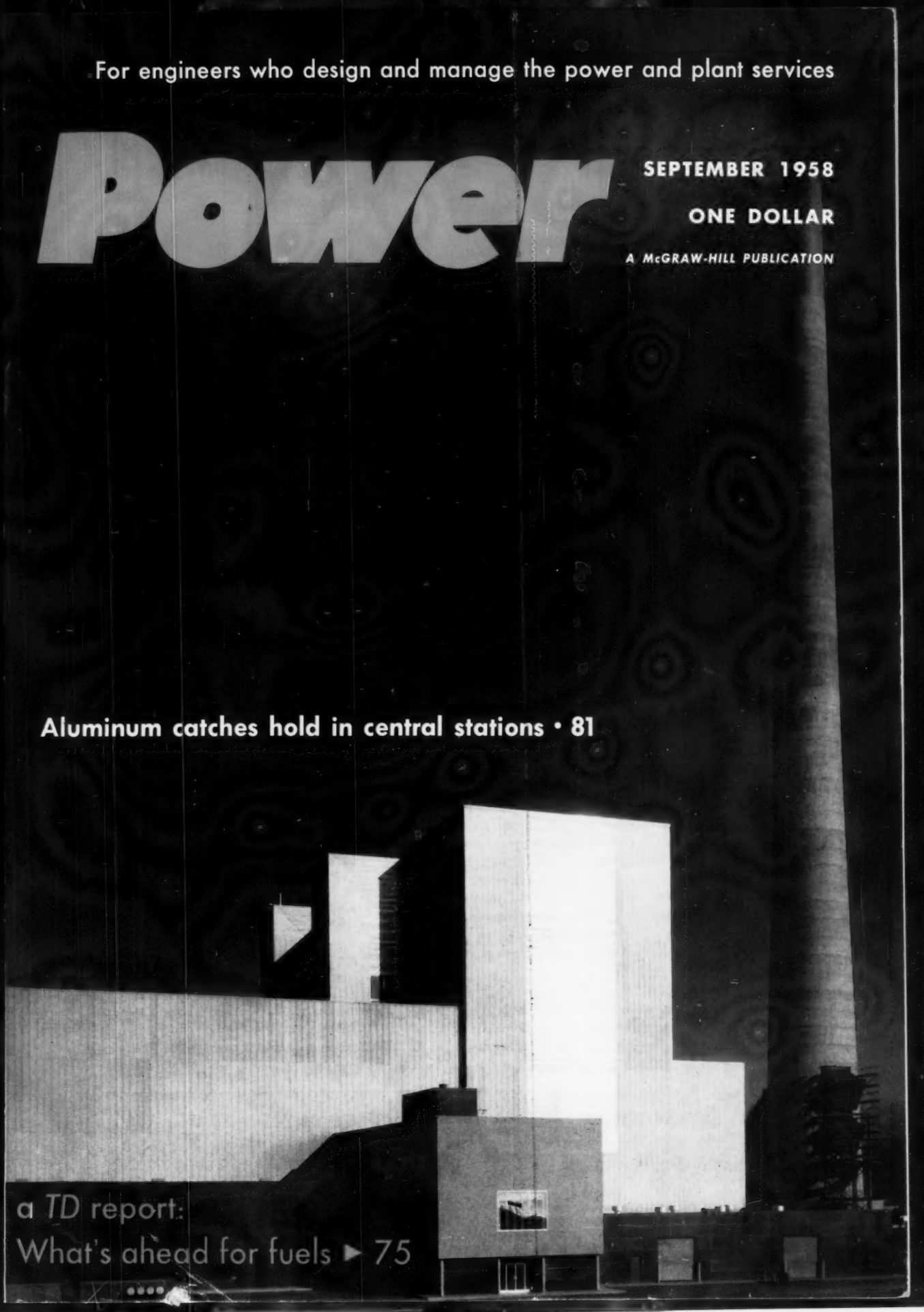
For engineers who design and manage the power and plant services

Power

SEPTEMBER 1958

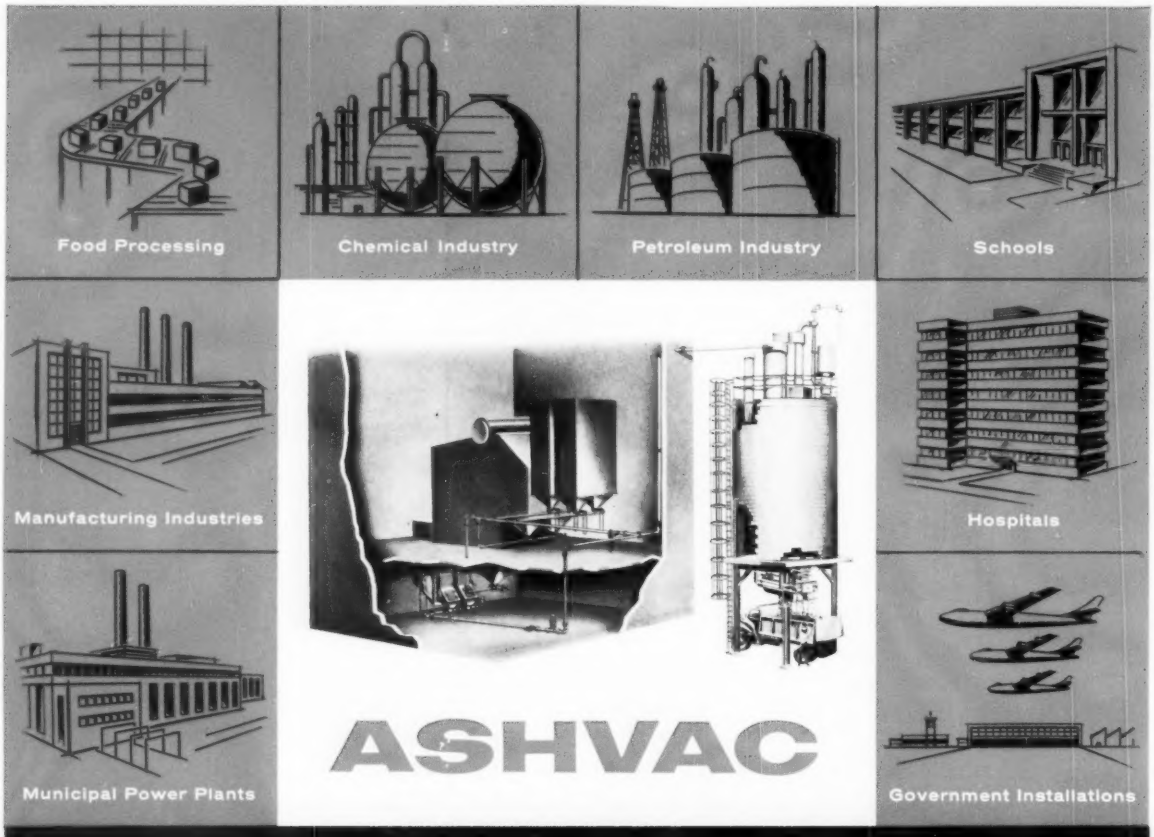
ONE DOLLAR

A McGRAW-HILL PUBLICATION



Aluminum catches hold in central stations • 81

a *TD* report:
What's ahead for fuels ► 75



Removes Boiler Ash* THROUGHOUT INDUSTRY

The use of ASHVAC (The Allen-Sherman-Hoff Co.'s trade name for their small, steam-jet pneumatic ash removal systems) cuts horizontally across *all* industry. ASHVAC Systems are installed in the central steam plants of schools and colleges . . . textile mills . . . food processing plants . . . municipal power plants . . . hospitals . . . petroleum refineries . . . chemical processing plants . . . all types of governmental installations . . . all kinds of manufacturing plants. ASHVAC finds application in the small and medium size steam generating plants anywhere coal is burned.

Three good reasons why power engineers *specify* ASHVAC Systems:

ASHVAC is PROJECT ENGINEERED—There is no "package" system for all applications. Each job is different; ASHVAC uses standard components in a system engineered to the job's specific requirements.

ASHVAC is PRICED RIGHT—Years of experience have enabled us to standardize many components, reducing manufacturing costs. A-S-H operates its own manufacturing plant—another cost saving advantage passed on to our customers.

ASHVAC is BACKED BY EXPERIENCE—The Allen-Sherman-Hoff Company has pioneered in the solution of ash handling problems. Behind every job is 37 years of experience—giving you the best, cleanest and cheapest system to operate.

* *A-S-H service doesn't stop with installation. When service problems come up, we stand ready to give prompt service assistance. This is a policy worth considering when suppliers are being selected.*

MATERIALS HANDLING SYSTEMS

"Hydrojet" *hydraulic*

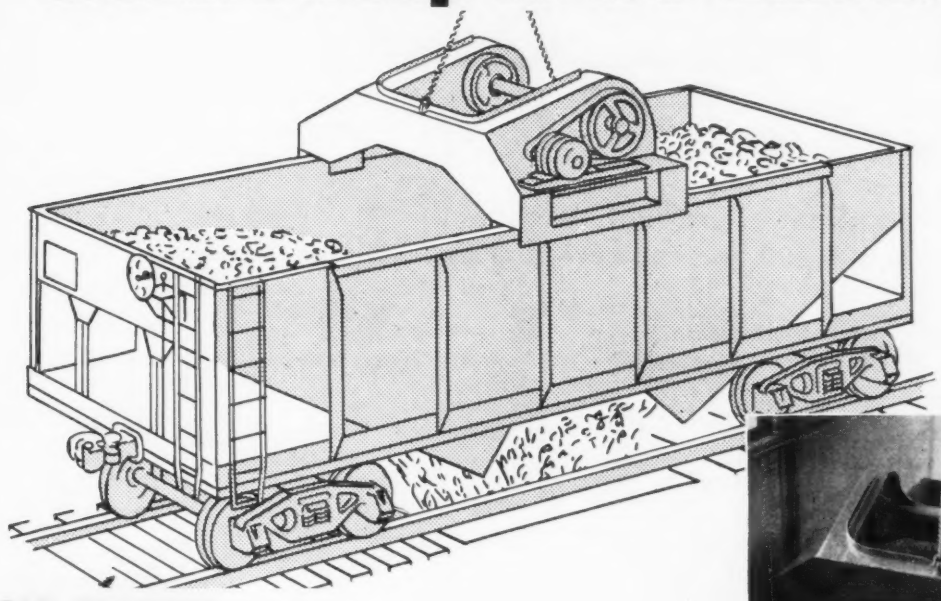
"Hydrovac" *pneumatic*

the **Allen-Sherman-Hoff** company

259 E. Lancaster Ave., Wynnewood, Pa.

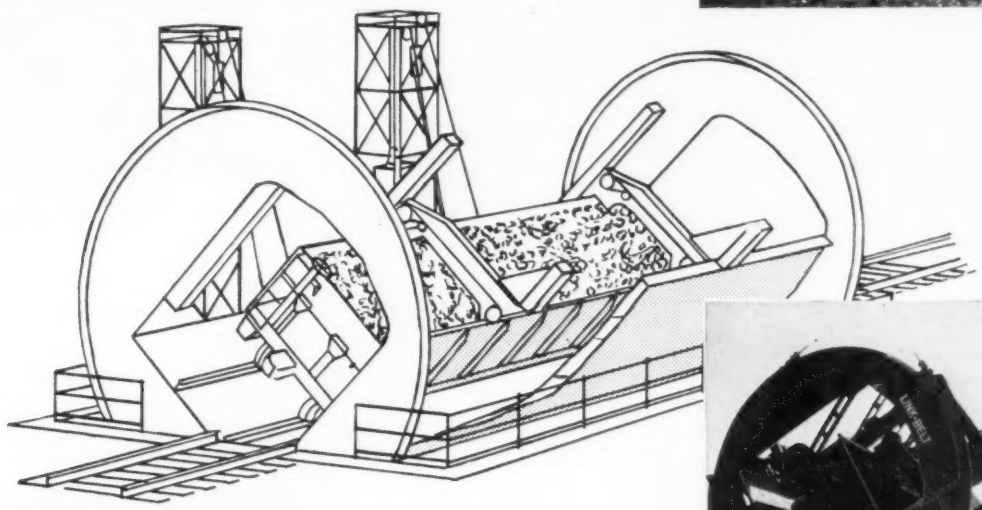
Offices and representatives in principal cities

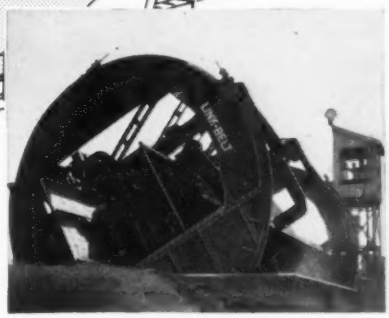
Clean sweep in car unloading!



CAR SHAKERS

FAIR SHAKE for coal cars. Wear to cars is no more than that encountered in normal operations over road bed. Objectionable noise can be reduced to a minimum. Shaker produces a series of hammer-like blows on the top of the car sides loosening even the hard-packed loads in minutes. Especially good for damp, sticky or frozen loads.





ROTARY DUMPERS

GOOD TURN for large plants. Link-Belt Rotary Dumpers empty a 90-ton gondola car every 45 to 90 seconds (including return to upright position) by simply turning car upside down. Car is securely held in rotating cradle and contents are completely dumped in one operation. Simple, automatic, fool-proof. Takes all open-type cars—any length, width or height.

Only LINK-BELT makes both shakers and dumpers . . . broom-clean unloading for any plant capacity

You can meet any coal unloading need with equipment by Link-Belt. For large operations a Link-Belt Rotary Dumper will unload 20 or more cars per hour. For smaller plants, Link-Belt Car Shakers are available. Both are engineered to do a specific job faster . . . easier . . . at lower cost. Both reduce operational hazards and cut costly demurrage charges.

Call your nearest Link-Belt office. We'll be happy to give you additional facts on Link-Belt Car Shakers and Rotary Dumpers.

LINK-BELT

CAR SHAKERS AND ROTARY DUMPERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14,952

DE LAVAL-STOECKICHT

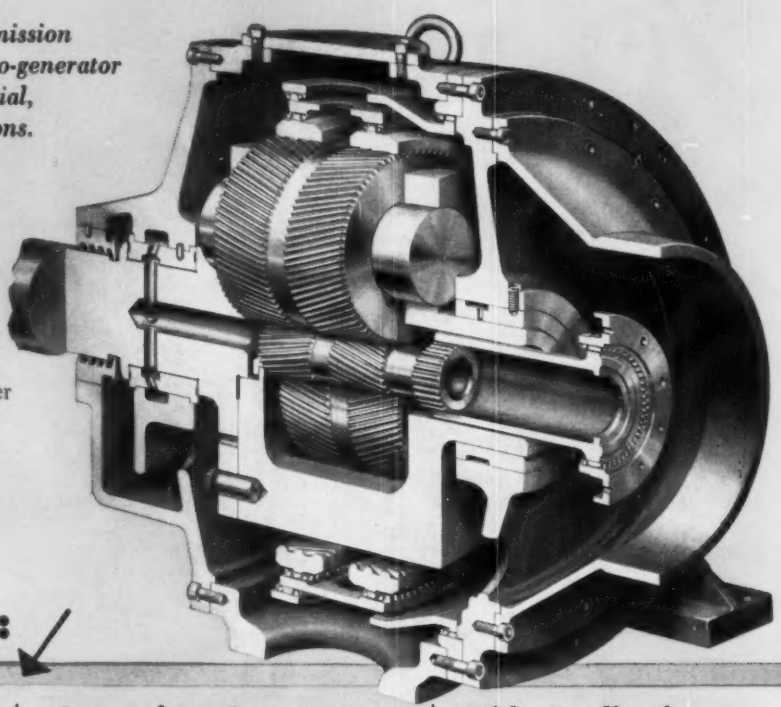
PLANETARY GEAR

...for high speeds...high horsepower

Proved in hundreds of installations abroad totalling over 3,000,000 horsepower—now available in America!

For all high torque power transmission applications such as pump turbo-generator and compressor drives in industrial, municipal and marine installations.

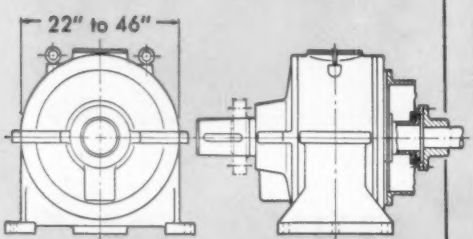
This cutaway view of the De Laval-Stoeckicht Planetary Gear shows how it provides flexibility for proper load distribution throughout the gear members. The thoroughly proved and tested design is completely reliable in transmitting high horsepower for high speed applications. • Highest efficiencies (98% or higher)...no high speed bearings...less friction losses.



Check These Advantages:

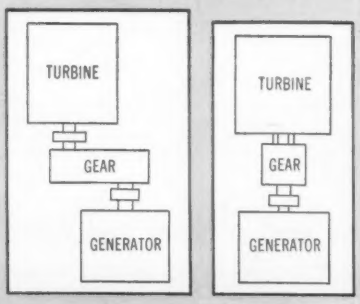
Small Size—Light Weight

Compact—low weight per hp. Sizes range from 22" to 46" in diameter, depending on horsepower requirements. Example: 5000 hp planetary unit weighs 1700 lbs. against 6000 lbs. for conventional gear.



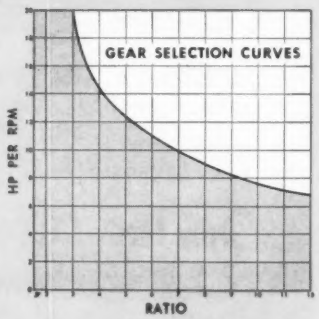
Convenient Arrangement

Co-axial or "in-line" arrangement of gear members takes up far less space than parallel axis gears of equivalent horsepower rating.



Wide Application

Capacity range shown in shaded area on chart below. For other applications, contact your De Laval Sales Engineer.



For further details, write for Bulletin 2400.

DE LAVAL *Steam Turbine Company*

815 Nottingham Way, Trenton 2, New Jersey

DL431

In Power this month

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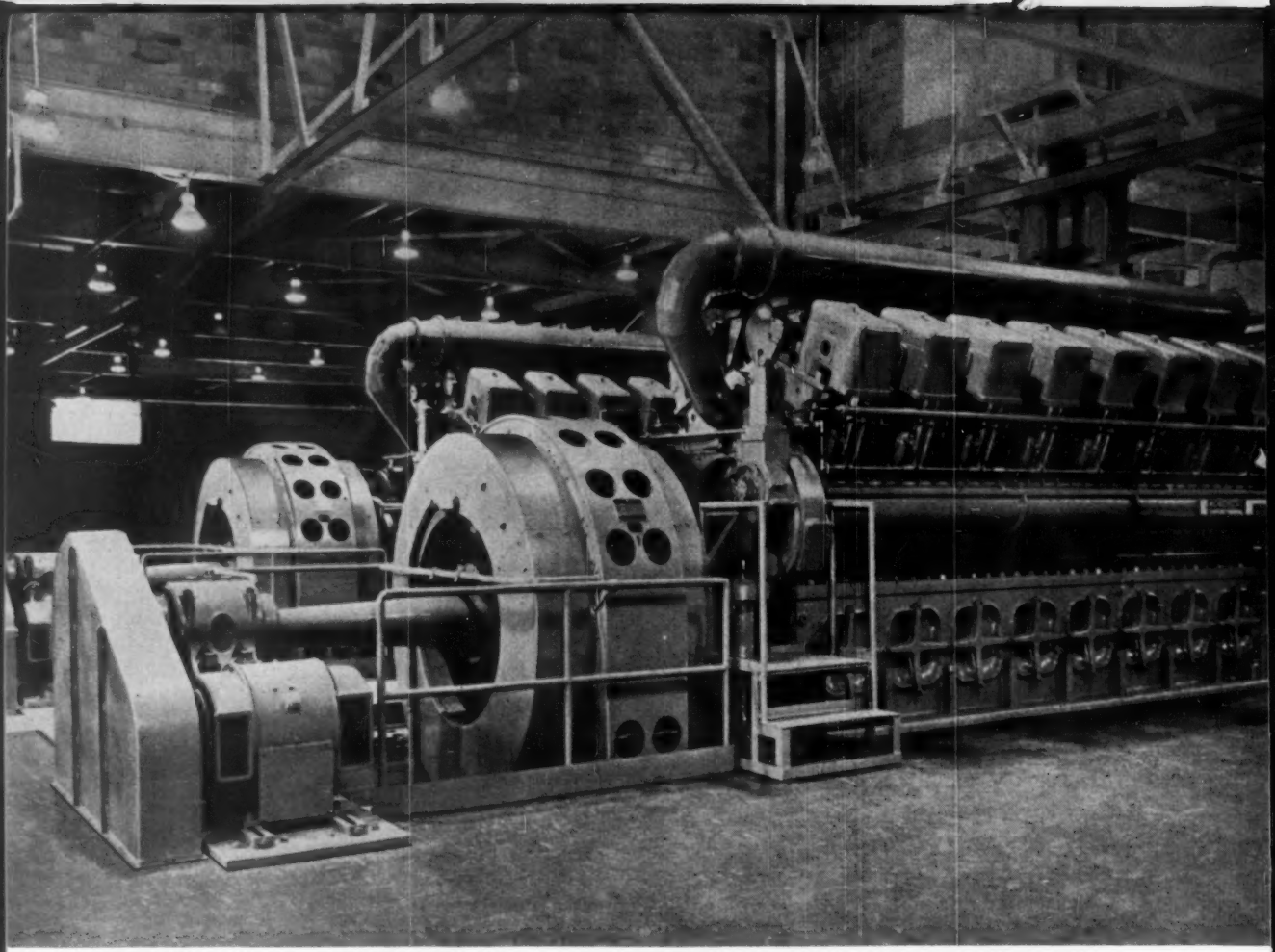
DL491



Texaco Ursa Oil lubricates each of these V-type 16-cylinder diesels which supply standby power in Narragansett Electric Co.'s Westerly, R. I., plant.

Bore and stroke of each engine is 13 x 16½"; each is rated at 3,500 hp at 514 rpm. Each generator has a net rating of 2,500 kw.

Texaco Ursa Oil protects Narragansett's reserve power

Narragansett Electric Company uses these two Supairthermal V-16 diesels for standby power. It's essential that these engines be instantly available, even after long periods of idleness. That's why Narragansett uses Texaco Ursa Oil to protect engine power, keep it reliable and ready—anytime.

With Texaco Ursa Oil in the crankcases, Narragansett engineers are certain of getting full rated horsepower because Texaco Ursa Oil keeps rings free and prevents the formation of harmful deposits. And because Texaco Ursa Oil is a premium quality lubricant, it protects against wear, minimizes operating and maintenance costs.

There is a complete line of Texaco Ursa Oils refined and processed especially for the lubrication of diesel, gas and dual-fuel engines. In fact, *for over twenty-years, more stationary diesel horsepower in the United States has been lubricated with Texaco than with any other brand.*

Your Texaco Lubrication Engineer offers his years of experience to help you select the right Texaco lubricant for your needs. You can contact him by calling the nearest of the more than 2,000 Texaco Distributing Plants, or by writing: The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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speaking of **Power**

Engineering economics is an important consideration in every business. Disregard it for any extended period and you're in the red. Subconsciously you deal with engineering economics every day in determining the most profitable course to follow in arriving at decisions: Should the design work for that new addition be let out, or can your own men handle it? Is it more practical to have that new oven fabricated by an outside contractor, or in your own shops? On the maintenance side: In the small plant is it more economical to let out some part of your maintenance to a contractor, or build up your own crew to handle the full job? Does it pay to replace lamps in a group, at planned intervals, or on an individual trouble-call basis?

This month Assistant Editor Norm Peach nibbles on one piece of this huge problem: motor rewinding. It was not too many years back when most industrial plants and central stations had their own motor-rewinding shops, staffed with their own mechanics. But rising labor costs, plus improved mass production techniques by motor makers, have changed this picture to some degree. In recent years, many a plant has dropped in-plant motor-winding repairs and started giving this work to outside specialty shops. Large plants, in the main, still have well-staffed motor repair and winding facilities.

But whether you have winding facilities or not, when a motor burns out you still face the decision (at least with the smaller units) of whether to chuck it in favor of a new one. That's one of the questions Norm deals with this month. To get the answer, he tapped the experts for their latest thinking on the smallest-sized motor it still pays to rewind. See p 114.

PLAN '59

Plant Design Issue, out next month, is POWER's contribution to the *McGraw-Hill PLAN '59* editorial program. It's packed with ideas on plant design, modernization.

Lon Lowley

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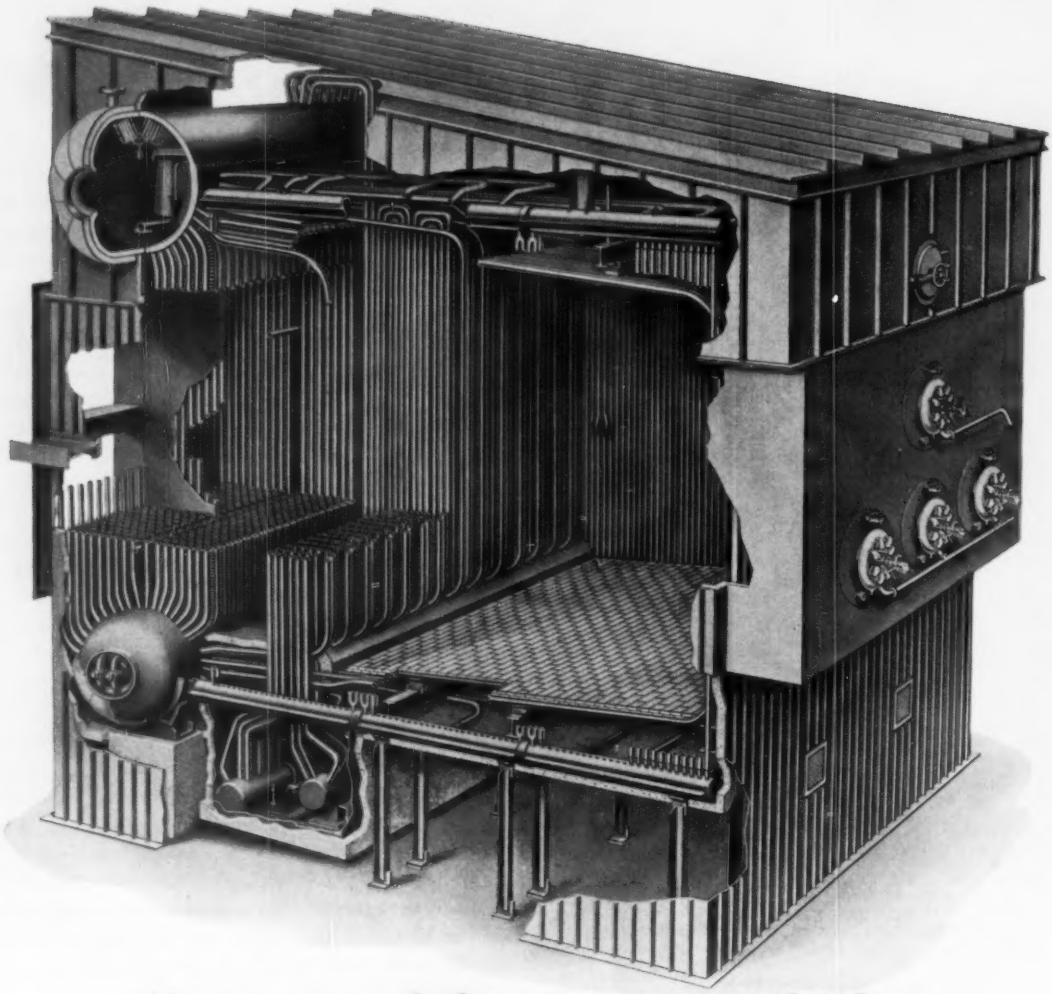

Here are eight ways in which the PFI Boiler can be of benefit to you:

1. It requires a minimum amount of space for a given power output.
2. The pressurized furnace design assures economy by eliminating the induced draft fan and air infiltration. This means savings in cost of fans, fuel, and operating power.
3. Pre-assembly of many of the components of the PFI Boiler is controlled in B&W shops, resulting in a reduction of the time and manpower required for field erection.
4. The PFI is designed to burn oil, gas, or a combination of the two. When it is equipped with a dual-fuel burner, it allows you to take advantage of favorable market conditions.
5. Cyclone Steam Separators ensure adequate water circulation which protects boiler tubes from overheating, even with wide and frequent changes in load. They also give you clean, dry steam at all designed ratings with high boiler water concentrations.
6. The drainable superheater design assures quick, safe start-up and ease of storage.
7. Water-Cooled Burner Throat eliminates troublesome maintenance, costly repairs.
8. All-welded Membrane Wall contributes to high efficiency and reduces insulation requirements.

Announcing New, Economical Power for Industry

New B&W PFI Oil-Gas Burning Unit Provides Maximum Output in Minimum Space

Here's an answer to industry's need for an economical, dependable steam supply. The new B&W Integral-Furnace Boiler produces high-quality, dependable steam economically at all ratings. Aptly named the PFI, the "Power For Industry" Boiler is compact, easy to install, quick to meet rapid and wide load swings. The new boiler gives long, sustained operation, requires little attention and is readily accessible for inspection, cleaning and maintenance.

All responsibility for your complete delivered and erected unit is accepted by one experienced, dependable source which in the past 25 years alone has placed over 4,000 Integral-Furnace Boilers in service. Behind *every* B&W Boiler is nearly a century of leadership in steam generation. A national network of B&W plants and engineering facilities means that the special skills of B&W engineers are always quickly available to you for service and assistance. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

For further information about the B&W PFI Boiler, write for Bulletin G-94.

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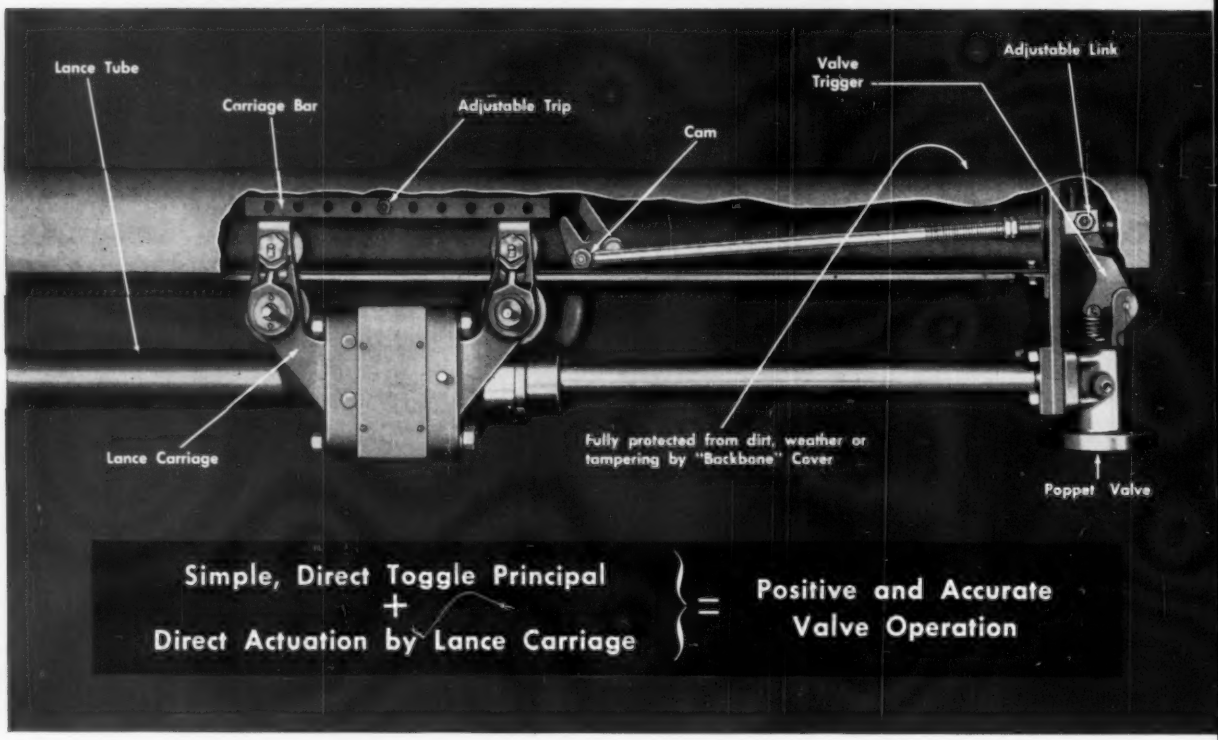


SERIES 300 IK—LONG RETRACTING BLOWER

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Compact, Accessible Electric Power and Control Terminal Facilities
- Front End Single-Motor Drive
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited, Windsor, Ontario

POPPET TYPE VALVE

(WITH ADJUSTABLE PRESSURE CONTROL)

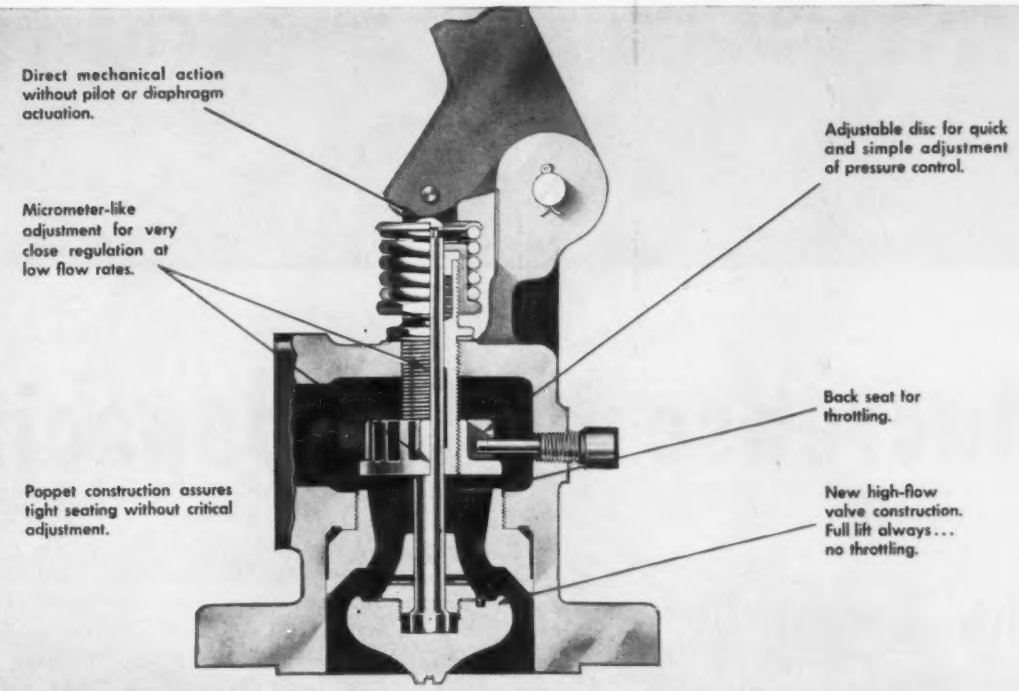
additional important features of the

New Diamond Series 300 IK
LONG RETRACTING BLOWER

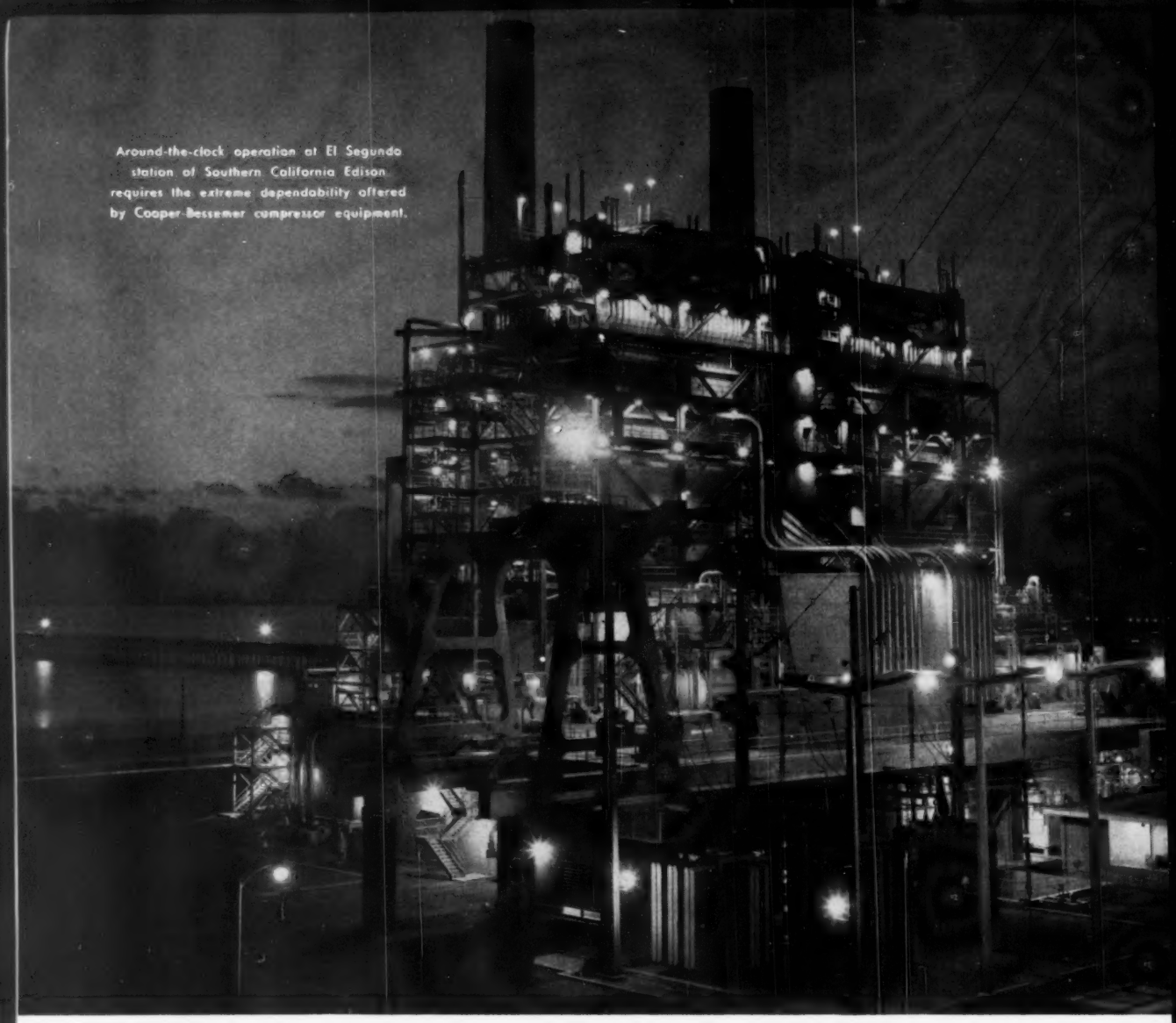
This valve was adopted for the new Series 300 IK because long experience has proved it the most satisfactory of all designs for severe blower service. More than 300,000 of this basic design are in use on various Diamond Blowers and have established notable service records. A recent improvement is more streamlined flow contours that permit higher flow rates with less pressure drop.

The direct mechanical linkage for actuating the valve offers the advantages of greater reliability and safety . . . in addition to more accurate control. Numerous other important features of the Series 300 IK are listed at the bottom of the left hand page. These are the reasons why this blower is establishing a new standard of efficiency, economy and dependability in cleaning heating surfaces that require a long retracting blower.

Bulletin 2111U tells much more about the Series 300 IK; ask your local Diamond office or write directly to Lancaster for a copy.


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Poppet construction assures tight seating without critical adjustment.
Adjustable disc for quick and simple adjustment of pressure control.
Back seat for throttling.
New high-flow valve construction. Full lift always... no throttling.

FULL LIFT AND FULL OPENING OF VALVE AT ALL TIMES. No throttling at main seat. ALL throttling for pressure control is between back seat and adjustable disc.



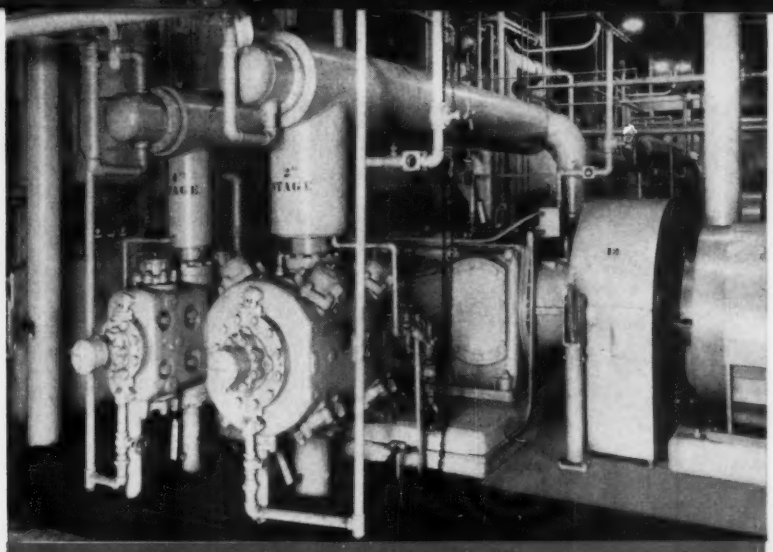
Around-the-clock operation at El Segundo station of Southern California Edison requires the extreme dependability offered by Cooper-Bessemer compressor equipment.

Increase boiler capacity,

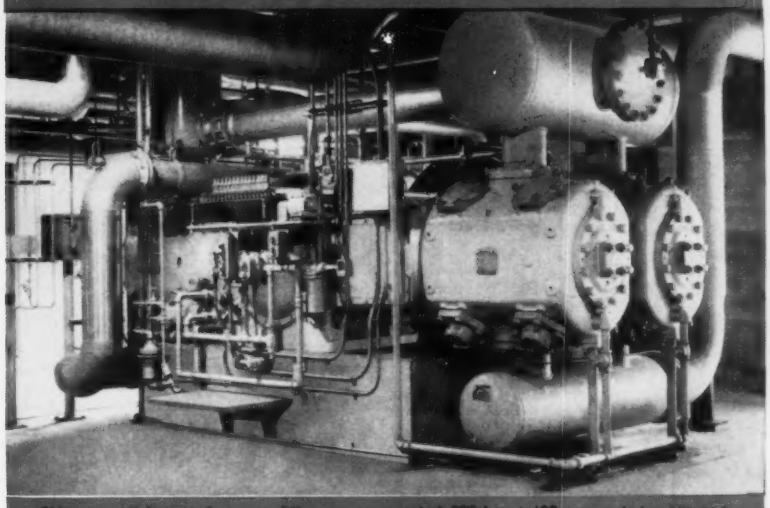
...with Cooper-Bessemer air Compressors for soot blowing service

Steam stations everywhere profit from multi-stage Cooper-Bessemer M-Line air compressors used to clean slag and ash deposits from boiler unit surfaces. For example, four steam stations of Southern California Edison Company, the Sayreville station of Jersey Central Power & Light Company, the Breed Plant No. 1 of Indiana and Michigan Electric Company, and the Philip Sporn Plant Unit No. 5 of the Ohio Power Company . . . *all* depend on the experience and efficiency offered by Cooper-Bessemer.

You'll find air cleaning with Cooper-Bessemer equipment the most effective and economical answer to a continuing problem. Automatic regulation, heavy-duty con-

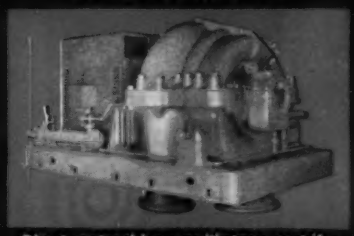


Extreme accessibility is another plus feature of motor-driven FM compressors in the Sayreville station of Jersey Central Power & Light.

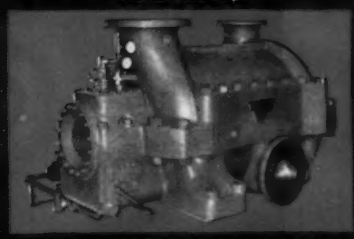


This compact Cooper-Bessemer FM compressor, rated 500 hp at 400 rpm, cuts trouble and costs at the El Segundo steam-electric generating station.

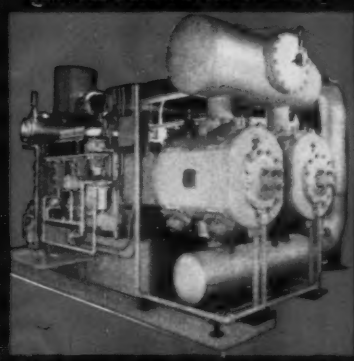
TO MEET SEVERE SERVICE REQUIREMENTS



Direct motor-driven multi-stage centrifugal compressors for sizes from 3000 cfm free air and up.



Multi-stage centrifugal compressors for sizes from 7000 cfm free air and up.



Multi-stage reciprocating compressors for up to 30,000 cfm free air.

availability and efficiency

struction and a range of horsepower sizes offer you the ideal unit.

For your next steam generating unit, check with Cooper-Bessemer for the latest in soot blowing services. Sizes are available up to 10,000 hp in both reciprocating and centrifugal designs. Write for additional information.

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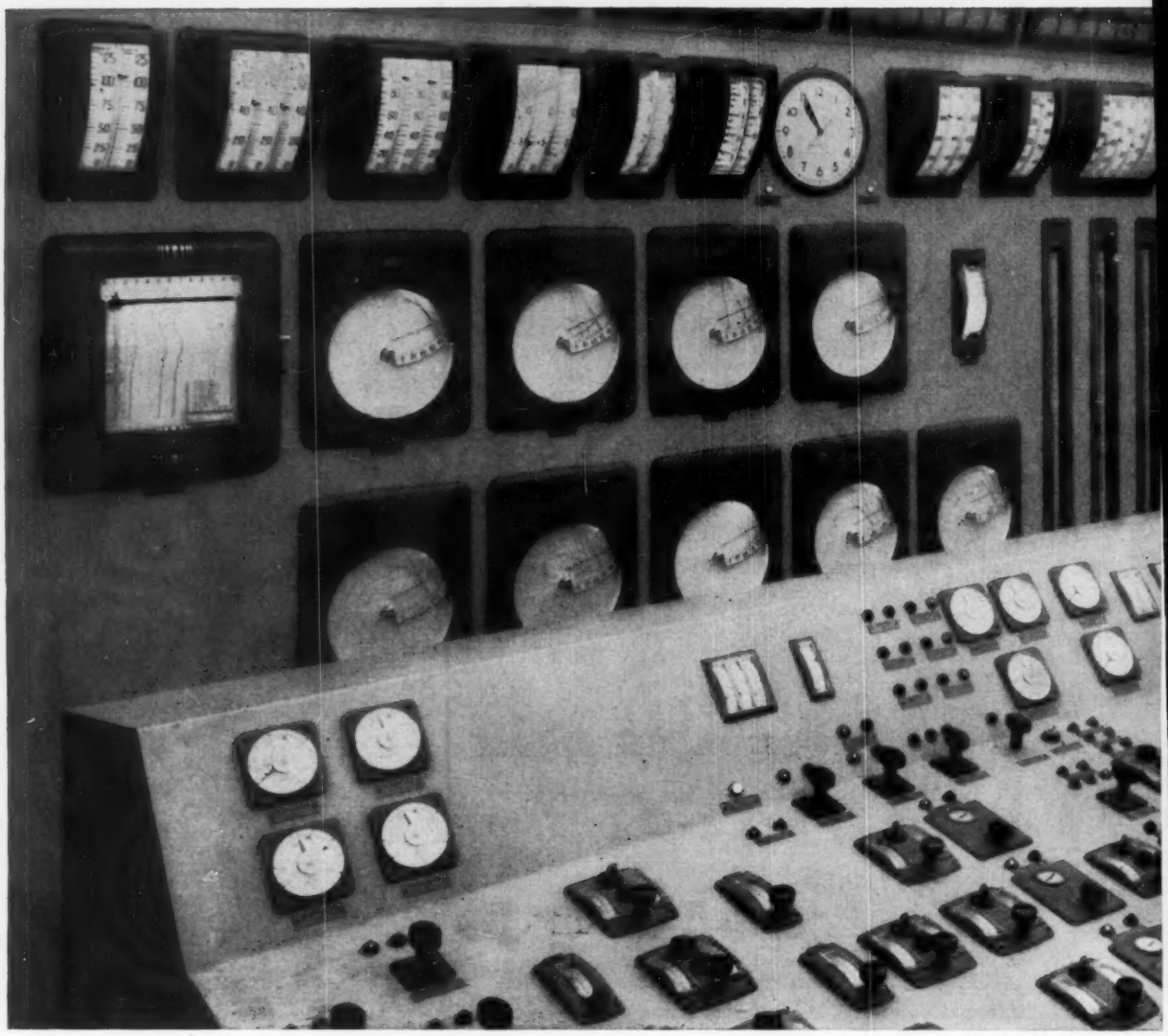
ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN



How Bailey puts, at your finger

Concentrated, here, in one centralized control room are all the meters and controls needed to operate a Cyclone Furnace Boiler. Bailey puts them at your finger tips. Makes operating duties a pleasure. Increases plant efficiency.

Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

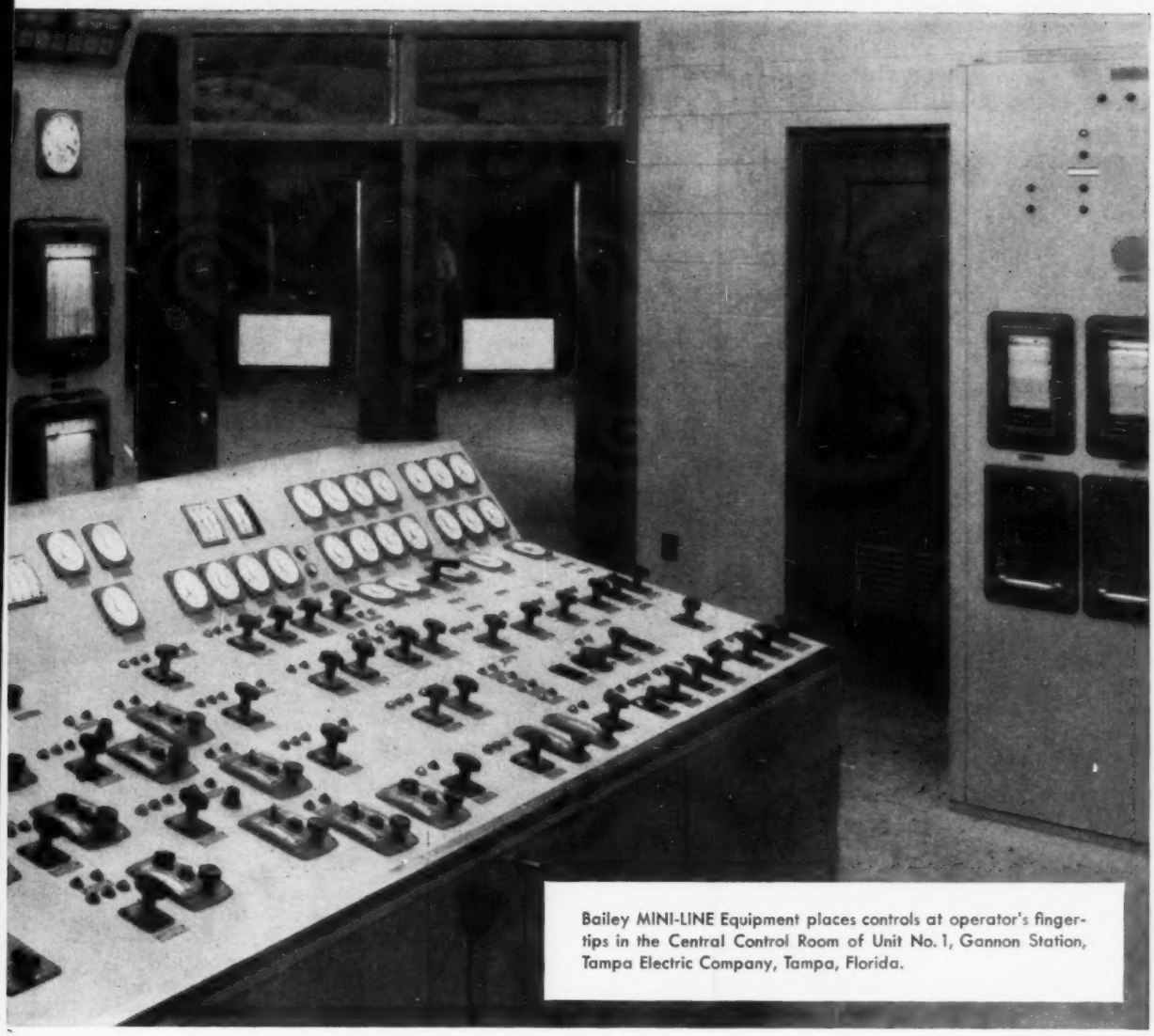
1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs.

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems of measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work efficiently for more than forty years. Veteran engineer and young engineer alike, the men who



Bailey MINI-LINE Equipment places controls at operator's fingertips in the Central Control Room of Unit No. 1, Gannon Station, Tampa Electric Company, Tampa, Florida.

tips, controls for STEAM PLANTS

represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your particular problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A137-2

Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

From pit to plant, LeTourneau—

New 400 HP LW-80—world's largest coal hauler—is 12' high by 12' wide, 54½' long. It hauls 100 cubic yards (80 tons) per trip at speeds up to 34 mph.

Westinghouse moves with coal

Earthmoving equipment manufacturer estimates steam generated from coal costs only half as much as competitive fuels

At LeTourneau-Westinghouse Co., Peoria, Ill., steam is used to heat an area that has swelled to a million square feet of space. Increasing demand created the need for a modern heating plant to replace obsolete equipment. When plans were drawn for the new plant, fuel surveys indicated that the firm should continue to use coal for availability and economy. Estimates showed that steam produced from burning coal in this area costs about *half as much* as from competitive fuels.

Today LeTourneau-Westinghouse has found that burning coal in modern equipment cuts costs in several ways. Fuel costs, of course, are at a minimum. Automatic, efficient operation has lowered coal and ash handling costs. And manpower requirements have been reduced from 12 to 7 men.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas, as in the case of LeTourneau-Westinghouse, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

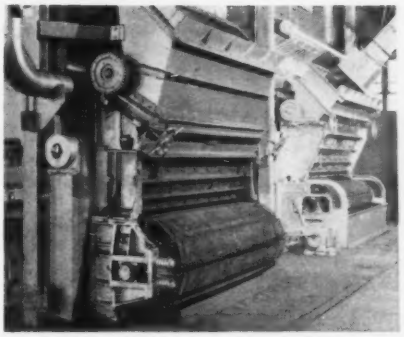
To help you with industrial fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

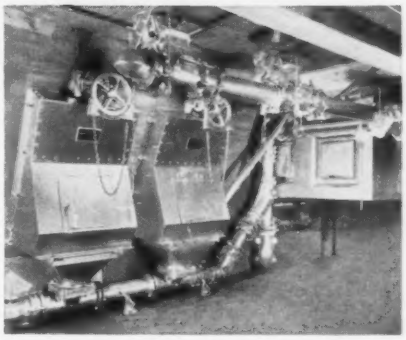
If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

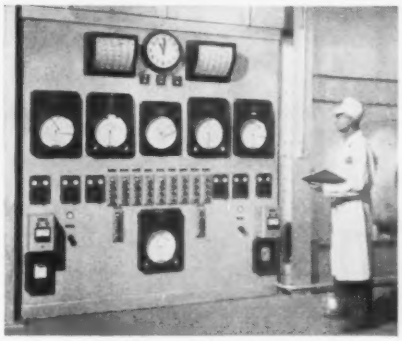
Department P-09
Southern Building, Washington 5, D. C.



View in the LeTourneau-Westinghouse heating plant. In foreground is an Erie City 40,000 lb/hr type I.W.T. boiler which is used on stand-by basis and for peak loads in extremely cold weather. At the right rear is Erie City 60,000 lb/hr main boiler. Both are fired by Combustion Engineering Inc. traveling grate stokers.

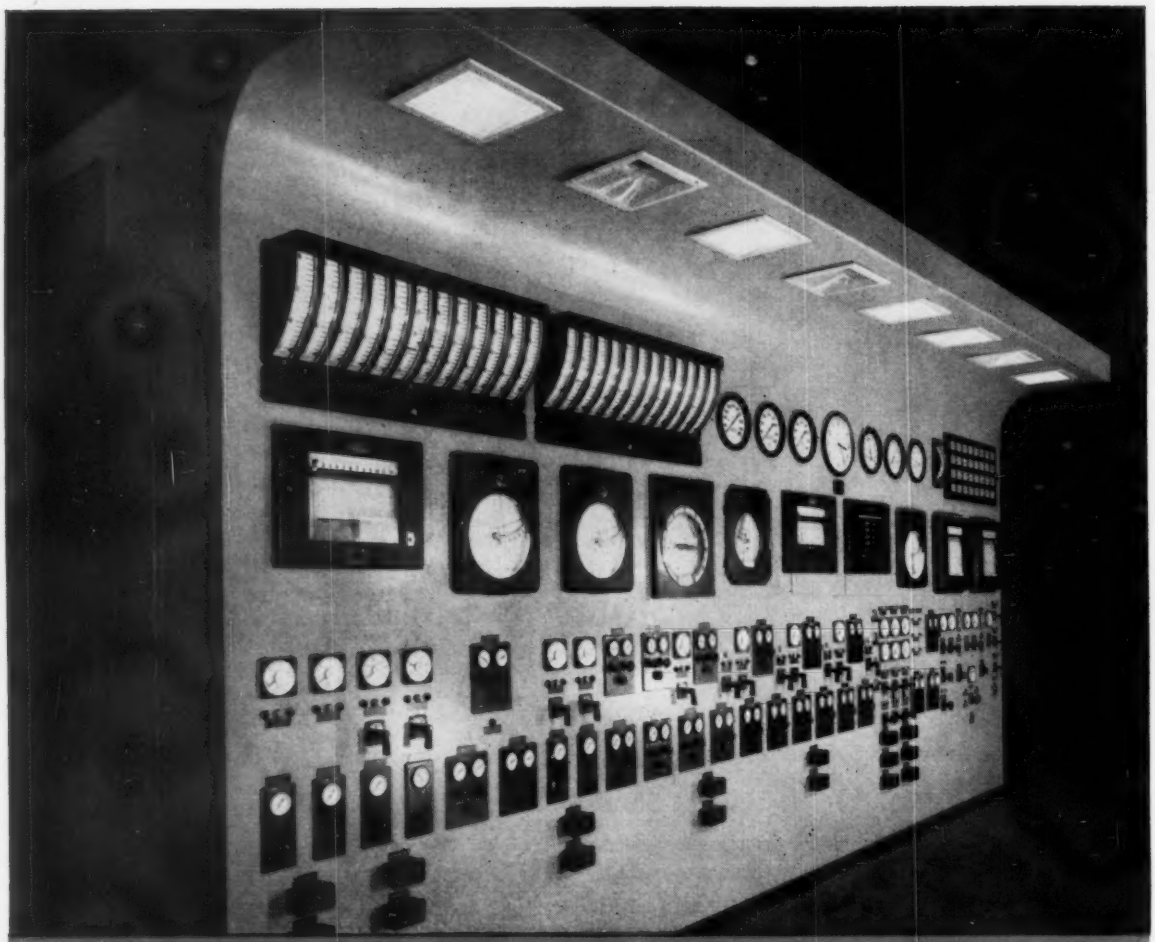


Shown are ash hoppers, part of United Conveyor ash handling system. Ashes are dumped from ash pits into hoppers from where they are piped pneumatically to silo. This system also handles dust from Prat-Daniel dust collectors.



Bailey Control Panel regulates both boilers, including boiler meters and recorders, feedwater controllers and alarms, drum level recorders and alarms, multipointer gages for draft control and return condensate recorders.

New heating plant showing 9000 cu ft Kalamazoo Tank & Silo Co. coal silo (on right). Coal feeds from railroad car into track hopper, then moves by screw conveyor to 40 ton/hr bucket conveyor which elevates coal to top of silo. Entire coal handling system by Beaumont-Birch Co. To left of coal silo is Kalamazoo 25-ton ash silo equipped with United Conveyor dustless rotary unloader.



Boiler Operating Panel. Built by Copes-Vulcan, this panel provides all necessary processing information. It permits firing the furnace or feeding water to the boiler automatically or by remote manual control. Identical Transet controllers and relays simplify maintenance procedures and minimize spare parts stocks.

Copes-Vulcan Boiler Control installed at Seward Station

Pennsylvania Electric Company's Seward Station uses an integrated Copes-Vulcan system to provide efficient boiler control. Built to maintain a constant main steam-header pressure under all load conditions, this modern control system provides simplicity of circuits and dependable accuracy of components.

Correcting pressure changes automatically. Fuel feed responds to deviations in steam pressure resulting from changes in steam flow rate, and generates the exact amount of steam to restore header pressure. The system also maintains constant drum level.

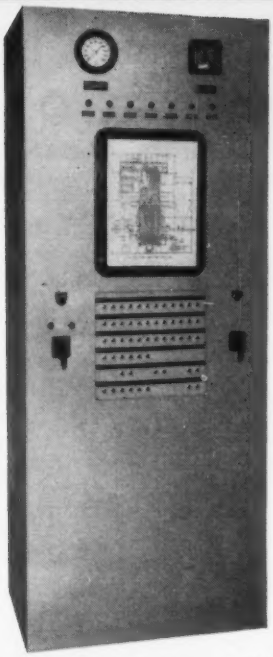
Mill temperature control, mill-totalizing circuit and boiler feed pump recirculation control are additional functions of this efficient control system.

Bumpless transfer simplifies operation. All Copes-Vulcan auto-manual stations provide a continuous picture of performance, permit automatic-to-manual selection without the complications of seal balance.

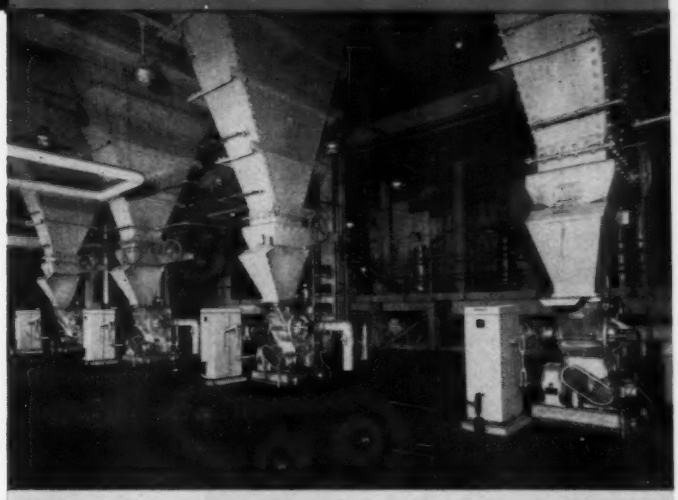
Noted for modern design, high speed response and precision performance, Copes-Vulcan boiler control systems and Vulcan soot blowing systems cut operating costs at modern stations everywhere.

Whether your boiler is large or small, power or process, your Copes-Vulcan representative has the ideas, information and experience to help you choose the system to best meet your needs.

C-V NEWS NOTES



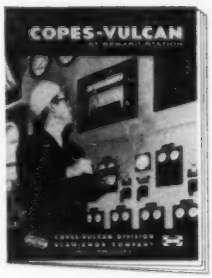
Seward's soot blower system. A Vulcan automatic-sequential control system keeps soot blowers operating in proper sequence. Panel switches permit any soot blower to be cut out of the sequence or reblown if necessary.

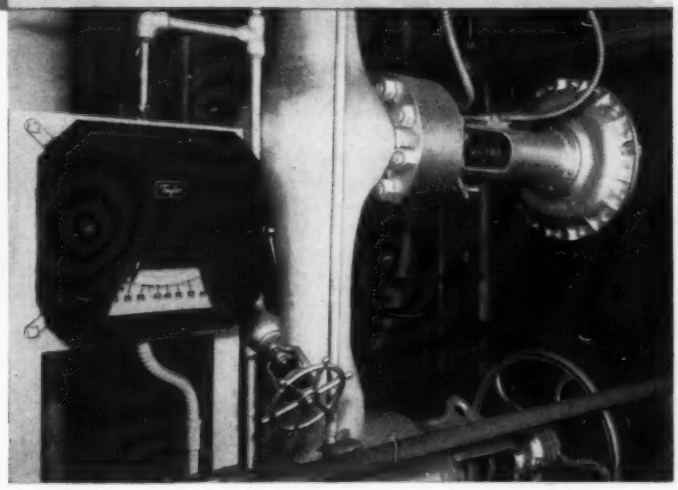


Fuel feed drive units. The units shown are typical of all drive units in the control system. A positioner, a four way valve, a power piston and feed-back cam are incorporated into each compact unit.

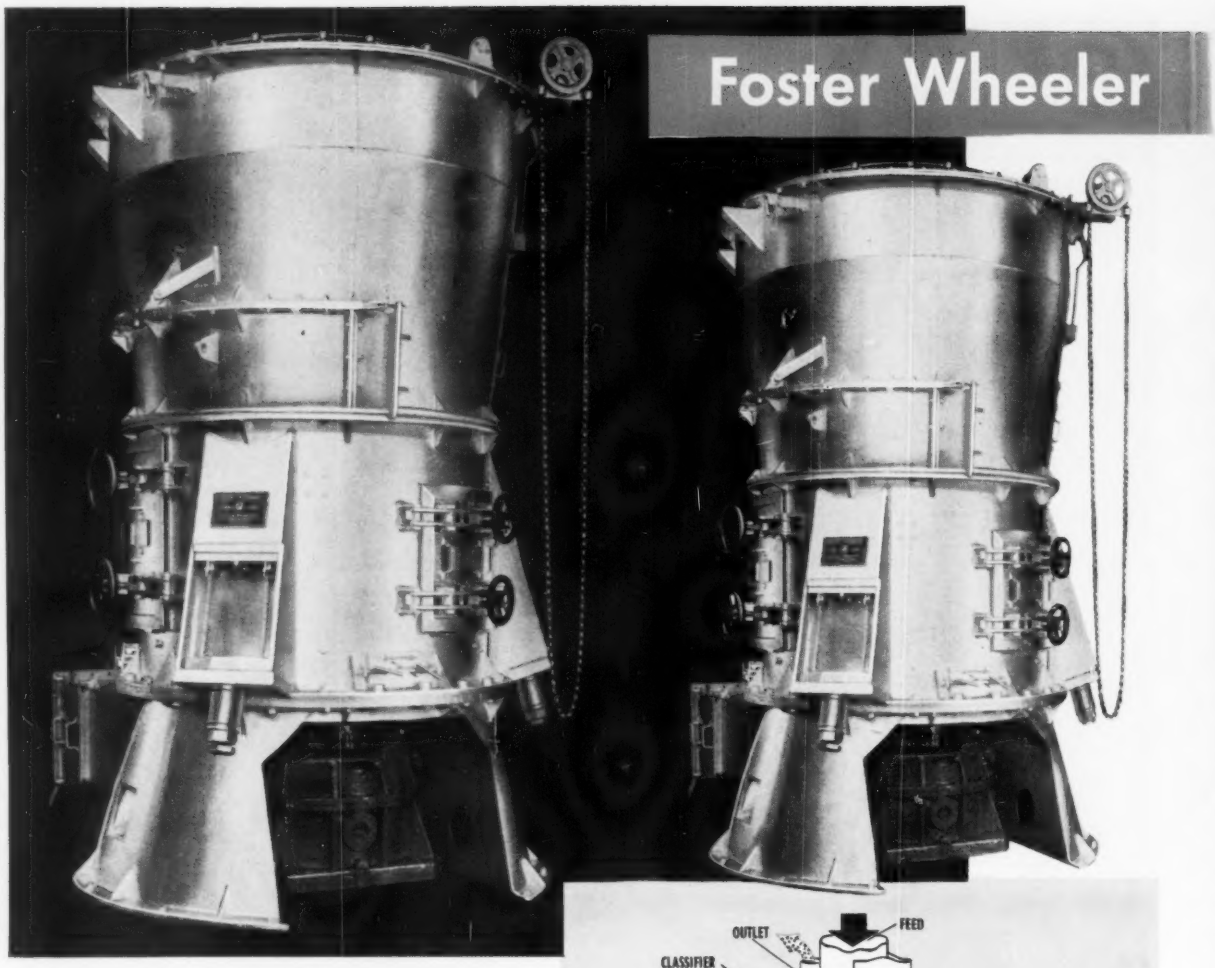
Pump recirculation control. When discharge from any pump falls below an established limit, an electric-contact low-flow control circuit opens a diaphragm operated by-pass valve to assure sufficient flow to prevent the pump from overheating.

Write for Bulletin 1038. This 12-page bulletin describes in detail Seward's complete control system. Schematic drawings show air-flow and fuel-loading loops. Boiler drawings locate Vulcan soot blowers and wall deslaggers.





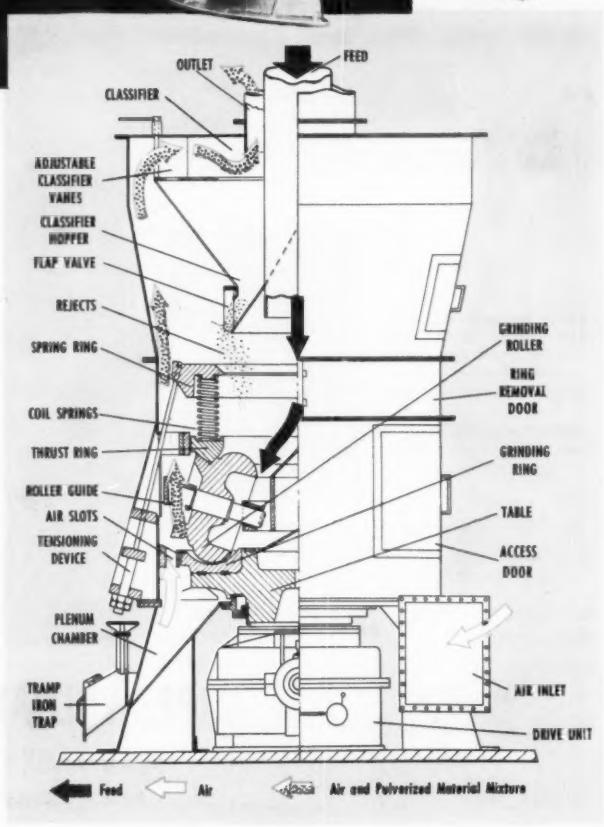
COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA



HOW THE MB PULVERIZER WORKS

In the MB Pulverizer, grinding action takes place between a slowly rotating horizontal table and three spheroidal rollers, uniformly spaced around the table and loaded by the adjustable thrust of a large number of heavy coil springs. The power driven table causes the rollers to rotate while circling planet fashion and rolling over the material on the table. The rollers move up and down independently of each other as required to compensate for foreign matter in the charge.

The charge, entering the mill, is fed directly onto the grinding table, where it is crushed between the table and the rollers. Air entering from below the pulverizer table, floats the ground particles up into the classifier, located in the top of the housing. Particles too coarse to be carried to the classifier fall back onto the table for further pulverization. The classified pulverized fuel is discharged through the outlet at the top of the casing.



"MB" PULVERIZERS

offer proved advantages of

LOW POWER CONSUMPTION and LESS MAINTENANCE

Planetary Roll and Table Design, with 9 years of successful operating experience in Europe, now available in capacities up to 60 tons per hour

THE FOSTER WHEELER Type MB Pulverizer is a simple, compact, planetary roll and table mill for pulverizing solid fuels to commercial fineness with exceptionally low power consumption, low maintenance cost and high availability.

Introduced in Europe in 1949, this type of mill has now had nine years of service experience, with excellent performance records and outstanding economy of operation. Its proved advantages, summarized below, can contribute materially to important savings in the cost of pulverized fuel for large or small steam generators.

Low Power Consumption. Efficient grinding action results in unusually low power requirements per ton of capacity, assuring lower operating costs, year after year.

Low Maintenance. Extremely rugged construction and easy accessibility of all wearing parts reduce down-time for servicing. There are no bearings or lubricated parts subject to dust and heavy pressure. Grinding ring and rollers wear *slowly* and *uniformly* and can be easily replaced when required.

Uniform Product Fineness. Throughout the life of the grinding elements, uniform product fineness is readily maintained without loss of capacity.

Pressurized or Suction Operation. With all moving parts enclosed in a stationary, air-tight casing, the MB Pulverizer can be used for either pressurized or suction operation, providing complete flexibility for various types of firing service.

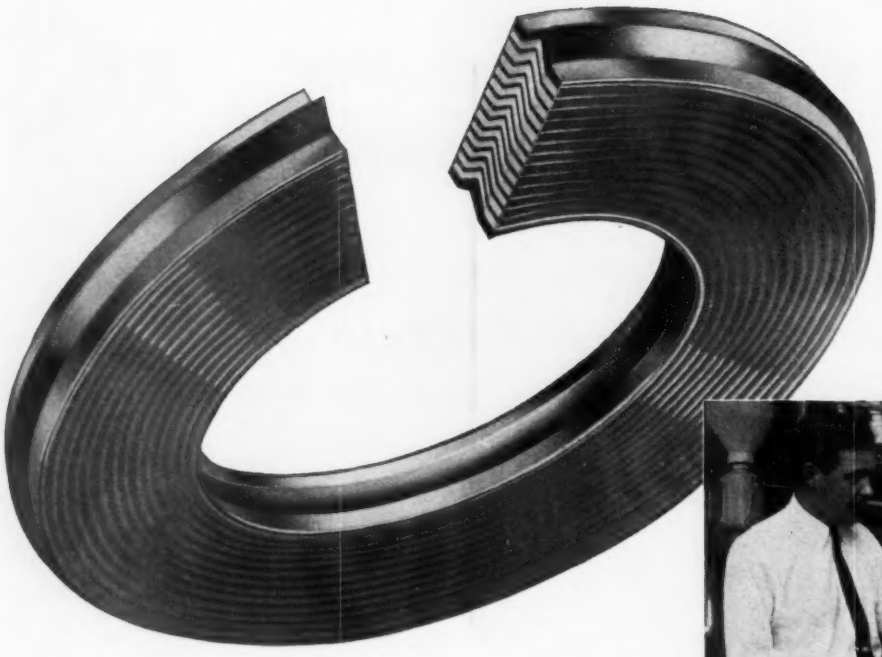
High Availability. All necessary adjustments for grinding pressure and particle size can be made externally while the mill is in operation, avoiding shutdowns except for periodic inspection or overhaul.

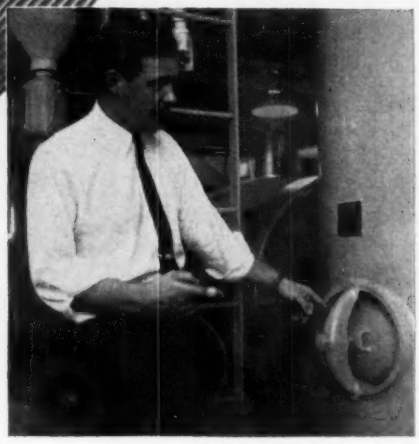
The type MB Pulverizer, with Foster Wheeler feeders, distributors, burners and fans or exhausters, provides a highly efficient and economical pulverized fuel system, supplementing the FW line of heavy-duty Ball Mill systems. For complete information, send for Bulletin MB-58-1. *Foster Wheeler Corporation, 666 Fifth Ave., New York 19, New York.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

Why POWER ENGINEERS with these





Automatic spring action of V-shaped metal plies react to variations in compression, internal pressures, and temperature changes. Assure leak-proof seal under most severe conditions.

GARLOCK GUARDIAN* GASKETS

Provide a safe, positive seal against high temperatures and pressures of steam, oils, gases, liquids.

Construction assures dependable sealing under varying service conditions. Strips of V-shaped stainless steel, alternated with layers of asbestos, are spiral wound to form the gasket. The number of windings are varied to accommodate different established bolt loads.

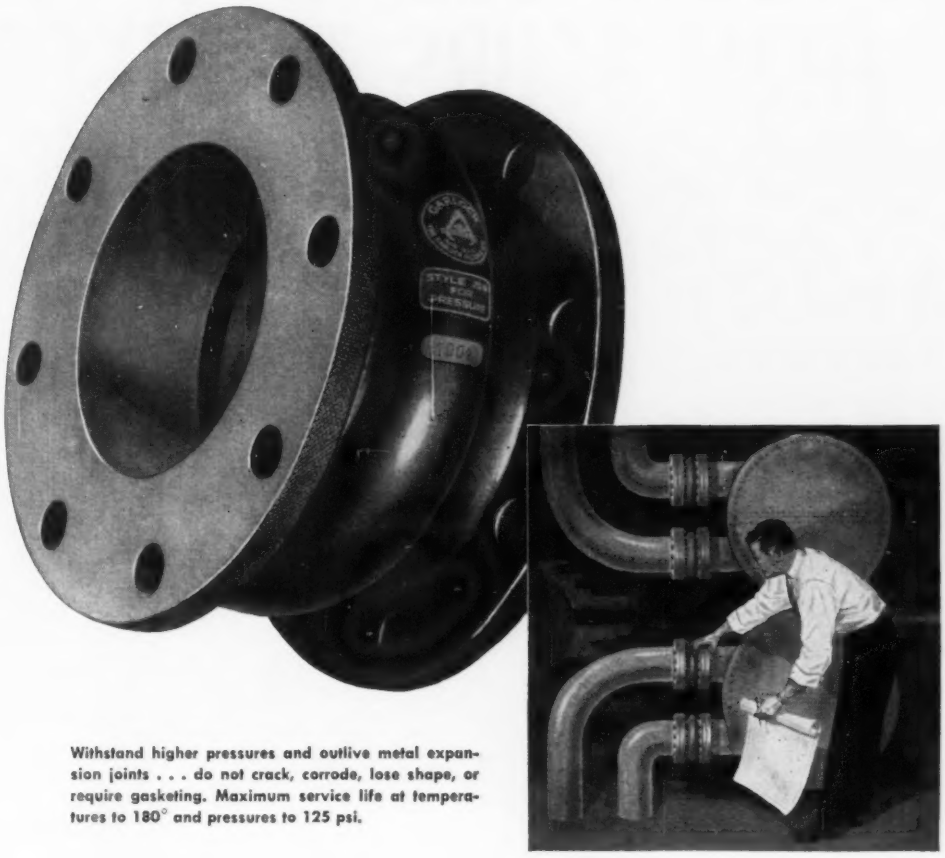
If you have sealing problems involving temperatures to 1050° F. and pressures to 2500 psi be sure to investigate the advantages of Guardian Gaskets. Available in round, oval, square, flat side, diamond, and pear shapes in practically any size. Write for descriptive folder AD-104.

*Garlock trademark

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

protect equipment GARLOCK products



Withstand higher pressures and outlive metal expansion joints . . . do not crack, corrode, lose shape, or require gasketing. Maximum service life at temperatures to 180° and pressures to 125 psi.

GARLOCK RUBBER EXPANSION JOINTS

Prevent flange breakage and equipment breakdowns. Undue stress caused by misalignment, vibration, expansion or contraction of piping or equipment will break connecting flanges. Garlock Rubber Expansion Joints relieve such stresses.

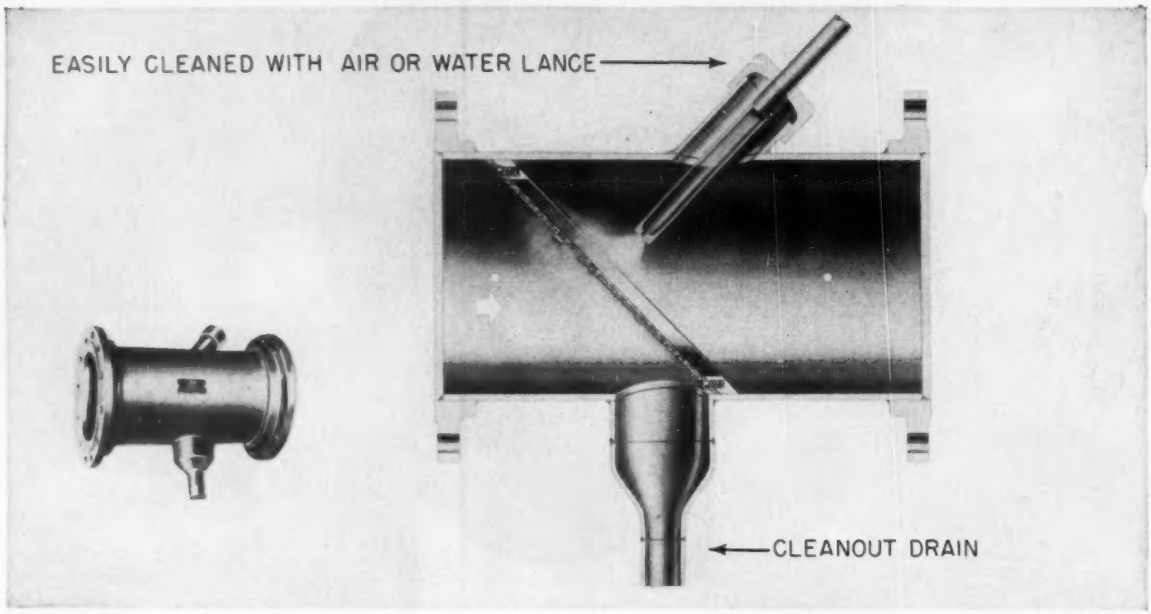
Eliminate vibration and noise. Pumps, compressors, engines, and pressure surges in pipe lines create vibration and objectionable noises. Garlock Rubber Expansion Joints act as an absorbent cushion . . . insulate against transfer of noise to other parts of the building.

These are only two of the many reasons why you should use Rubber Expansion Joints in piping systems for air conditioning, blower lines, brine tanks, jet condensers, pump lines, circulating water lines, etc. Write for Folder AD-137.

THE GARLOCK PACKING COMPANY
Palmyra, N. Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U. S. and Canada.

NEW START-UP STRAINER CUTS CLEANING TIME FROM HOURS TO MINUTES !



With this new start-up strainer, you can provide positive protection for new boiler feed, condensate and any other close-fitted pumps and eliminate costly standby construction labor during start-up periods for new piping systems.

Flushes Clean in Minutes

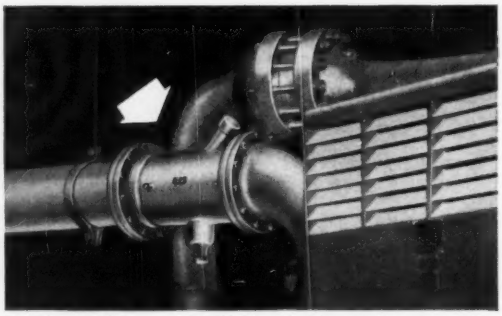
In actual field use, strainer cleaning time was cut from four hours (with basket, cone and disc types) to only ten minutes with the Leslie strainer. The strainer is easily cleaned by operating personnel with an air, steam or water lance as shown in the cutaway. Trapped debris flushes down the cleanout drain.

Easy to Install

Installation eliminates large complicated T's or angles. Screen is removed easily. You can leave the strainer body in the line after start-up or remove it for re-use and replace it with a spool piece. Available in sizes 6" to 16" steel construction with 150 to 300 lb. flanges.

More Information

Want more details? Just ask your Leslie Engineer. He's listed in your classified directory under "Valves" or "Regulators".



Here is one of 5 new Leslie Start-up Strainers installed on boiler feed and condensate pumps at New York State Electric and Gas Corporation's Milliken Station.

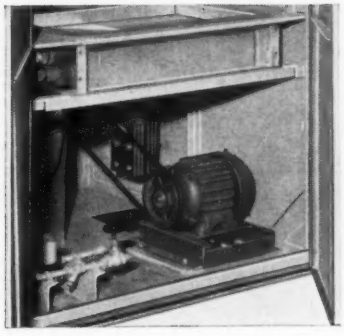
LESLIE

REGULATORS and CONTROLLERS
STRAINERS

LESLIE CO., 235 GRANT AVENUE, LYNDHURST, NEW JERSEY

SEMI-CONDUCTOR RECTIFIER

Two 100-kw, 250-volt silicon rectifiers installed in industrial service. Semi-conductor rectifiers are simple in operation and maintenance, require little floor space.



Effective cooling — closed recirculating air system features air-to-water heat exchange and delivers same amount of cooling air to each diode. Air is sealed in. Direct air cooling system also available.

Only application experience like this can give you highest conversion efficiency

High power conversion efficiency at low cost is the major advantage of the semi-conductor rectifier. But this high efficiency — as high as 95% — can be obtained only when the unit is *correctly applied*.

Allis-Chalmers 30 years of experience in developing, manufacturing and *applying* rectifiers assures you of the highest conversion efficiency. This background of experience, plus vast research and engineering facilities, is available for a thorough analysis of your requirements. Then, specific, unbiased equipment recommendations are made — dictated solely by your requirements — because Allis-Chalmers makes all types of rectifiers.

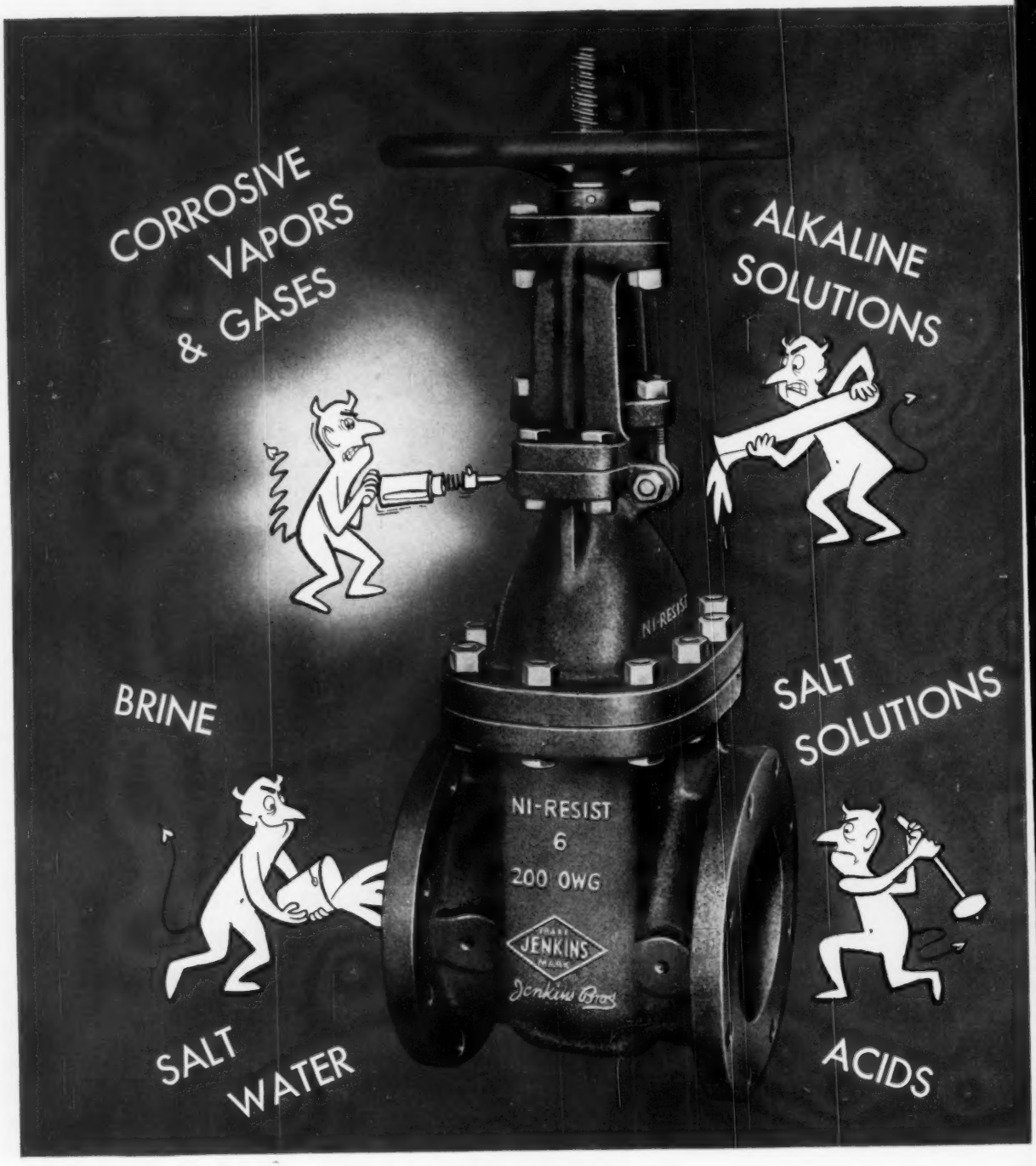
Every semi-conductor rectifier installed by Allis-Chalmers has performed to the complete satisfaction of the user. Your local A-C man can tell you how a semi-conductor rectifier can be applied profitably to your operations. Call him. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

A-5817

for longer valve life in a variety

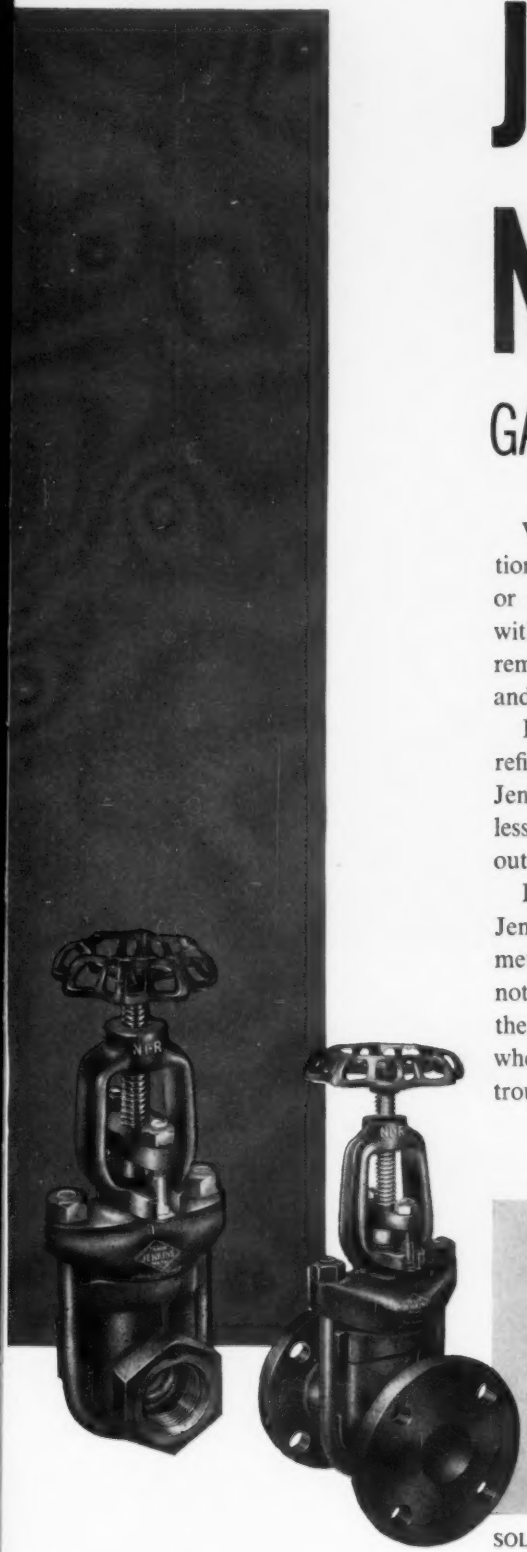


GET COMPLETE INFORMATION from your Jenkins Distributor, or write Jenkins Bros., 100 Park Avenue, New York 17. Ask for Bulletin 205.

of corrosive and erosive services

JENKINS NI-RESIST

GATE VALVES



Where you encounter acids, salt and alkaline solutions, sea water, brine or other corrosive fluids, vapors or gases, you'll want Jenkins Ni-Resist Gate Valves with type 316 stainless steel trim. They have a remarkable ability to withstand destructive corrosion and erosion.

In paper mill service, food processing, petroleum refining, chemical plants and other process industries, Jenkins combination of Ni-Resist and type 316 stainless steel, plus Jenkins extra *value* construction throughout greatly extends valve life.

Designed especially for corrosive services, the Jenkins Ni-Resist line of gate valves also has superior metal-to-metal wearing qualities. Copper-free, they will not discolor or contaminate products being carried in the line. Let the famous Jenkins Diamond be your guide when choosing Ni-Resist valves . . . it means longer, trouble-free service.

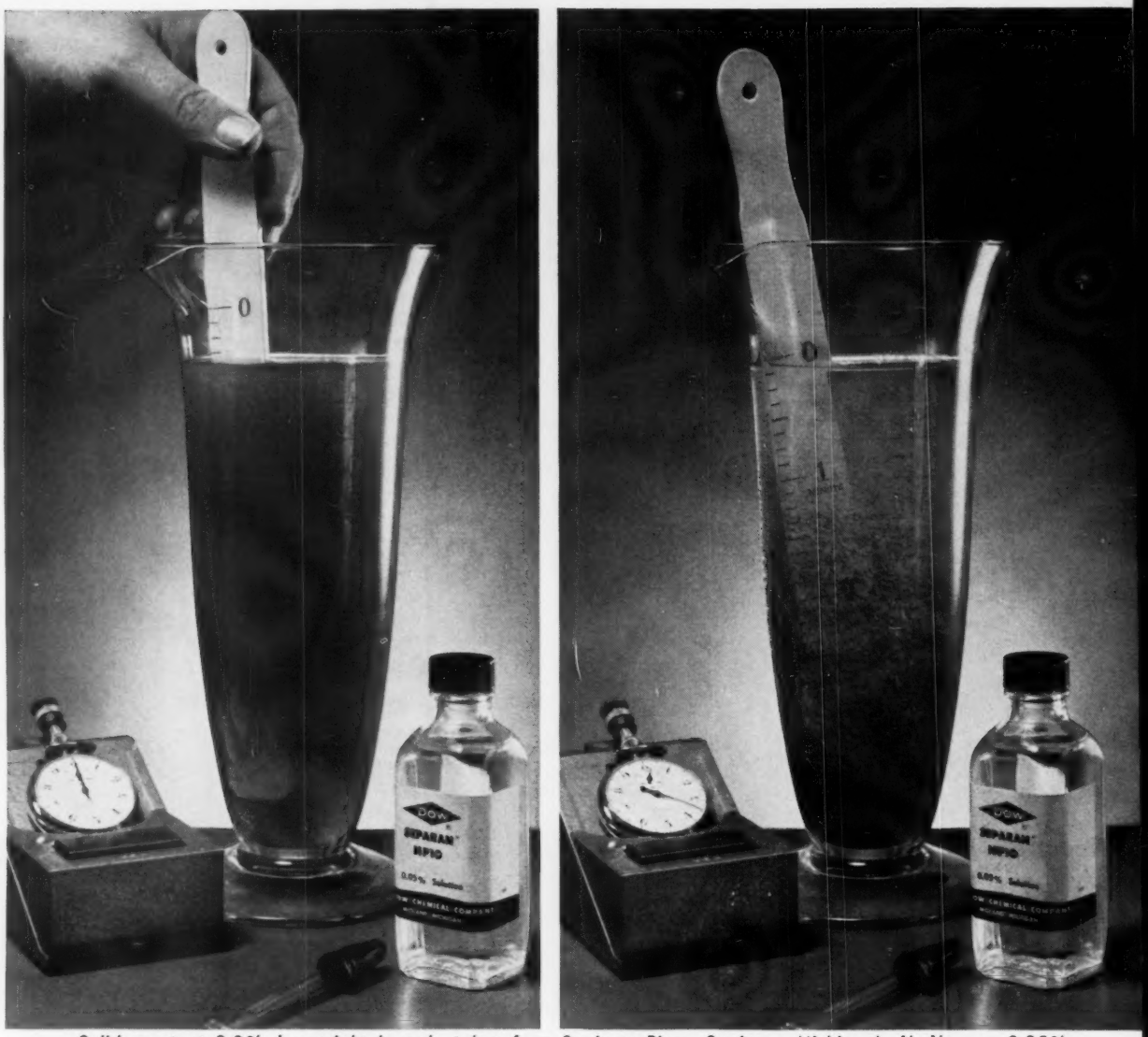
JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

JENKINS SINCE 1864

Jenkins Bros

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE



Solids content 0.2% by weight (sample taken from Saginaw River, Saginaw, Michigan). ¼-½ ppm 0.05%

Separan flocculants speed process water throughput . . .

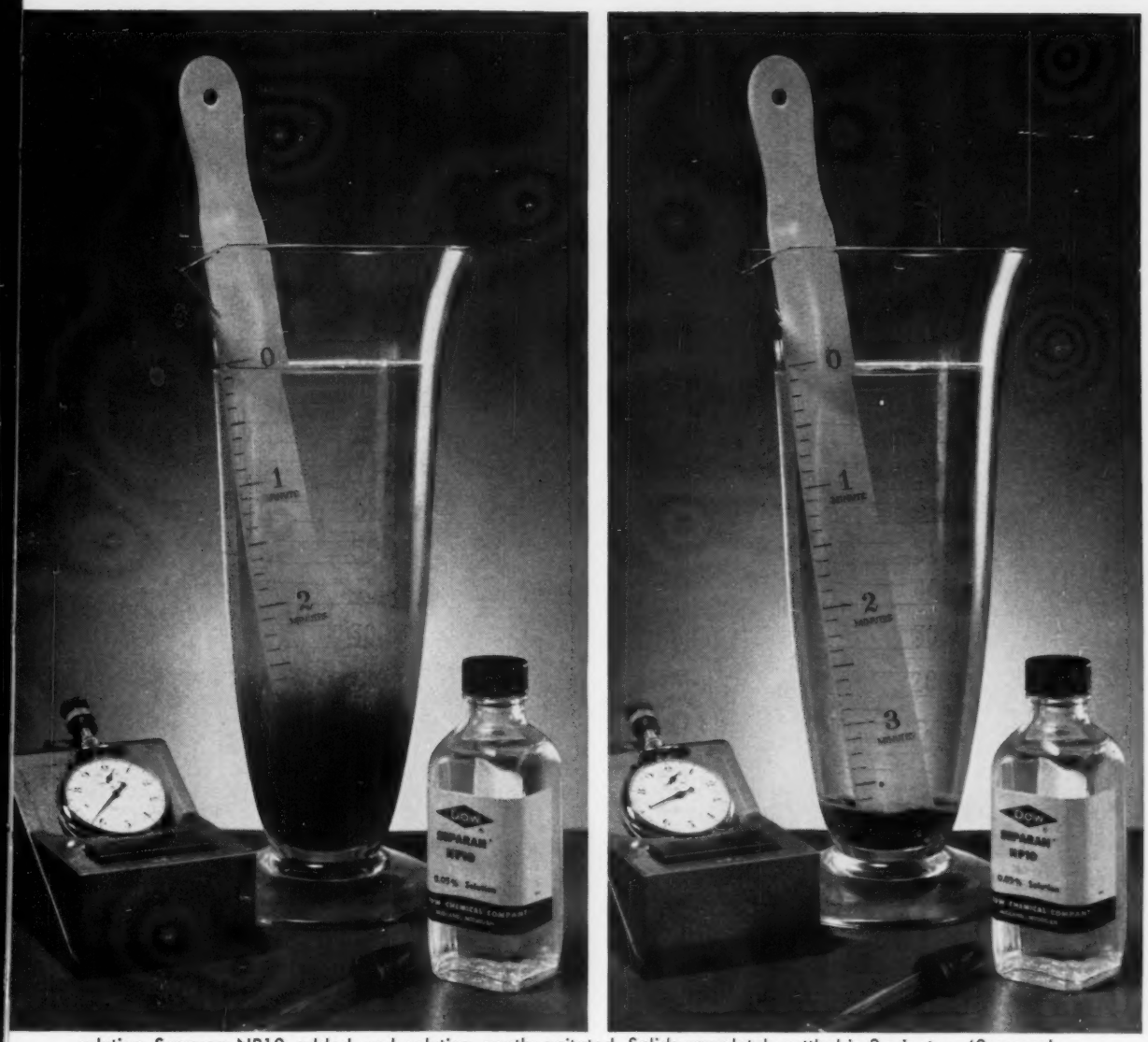
Dow's new high-powered flocculating agents, Separan® NP10 and NP20, are used by many engineers to clarify water for processing or cooling purposes—in a fraction of the time required with other flocculants!

Two particular characteristics make Separan flocculants very valuable. First, the speed with which they act. Second, the quality of the floc formed.

These properties speed sedimentation, filtration, clarification, softening and recovery operations under a wide range of pH conditions. No special equipment is needed. Separan flocculants are added to other flocculants (e.g. alum, ferric chloride) to enable the settling job to be accomplished in a fraction of the time normally required. Separan flocculants are synthetic, organic products—easy to disperse, easy and safe to use, noncorrosive. They are effective over a wide temperature range, require no heat or preservative.

Dow Stressing Flocculant Research. Separan NP10 (improved form of Separan 2610) and Separan NP20 may soon be joined by other new flocculants for specific uses.

Dow can help you trim your water treatment costs with flocculating agents, ion exchange resins and chelating agents. Contact your nearest Dow sales office for detailed information. Quantities of Separan flocculants are immediately available for your own testing and evaluation. THE DOW CHEMICAL COMPANY, Midland, Michigan, Engineering Chemicals Department 1057E.



solution Separan NP10 added and solution gently agitated. Solids completely settled in 3 minutes, 40 seconds.

without adding equipment!

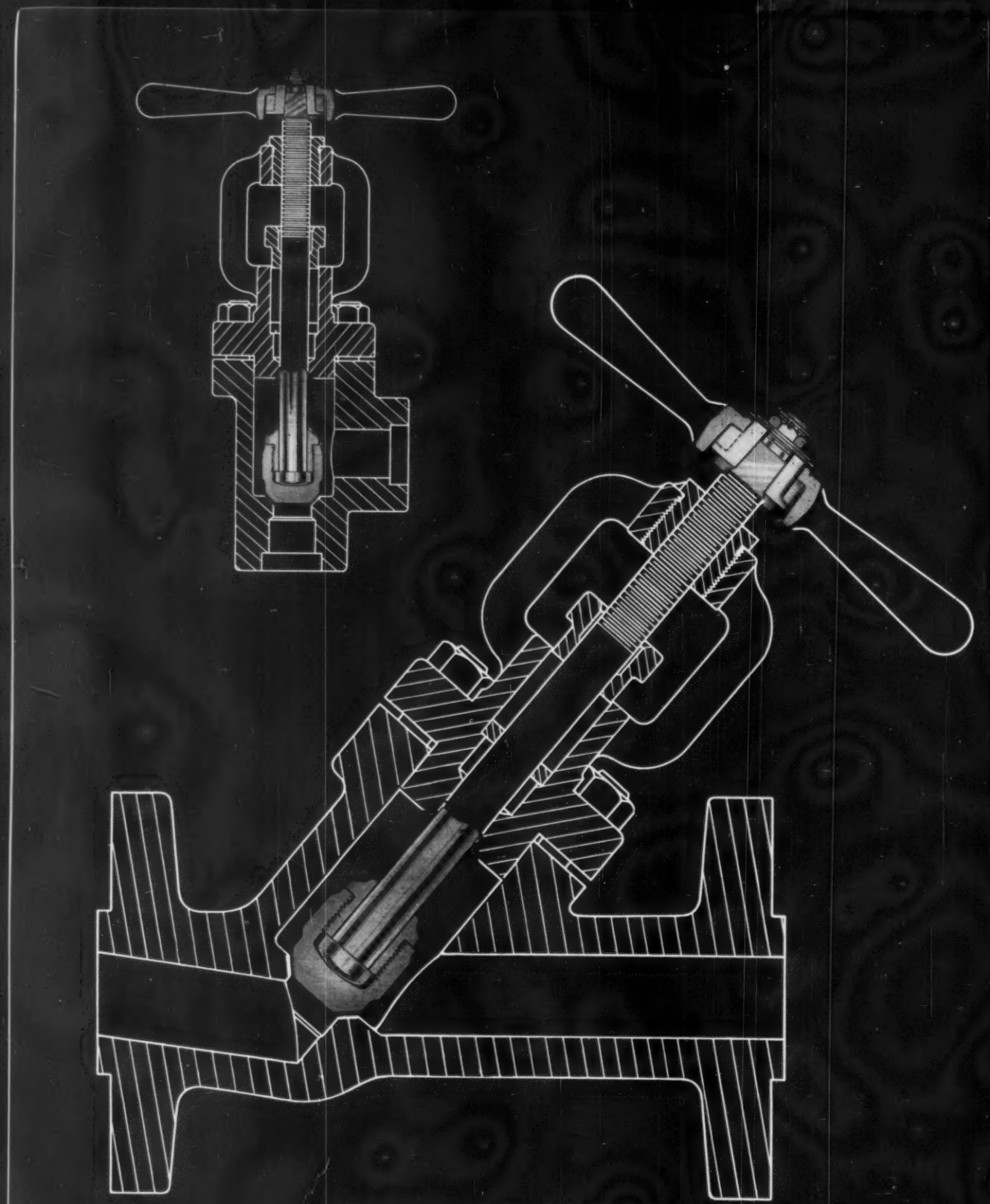
Separan NP10 (improved form of Separan 2610) offers greater clarity, higher purity and easier dispersibility!

Increased production in most types of water processing operations can be accomplished with a Separan flocculant—without extra capital investment!

YOU CAN DEPEND ON DOW

REPORTS OF SUCCESSFUL USE OF SEPARAN NP10 IN PROCESS WATER TREATMENT

Location	Water Source	Separan NP10 Used	Results
East	river	½ ppm added last to chemical mix & coagulation tank	Improved clarity, reduced color, increased capacity
Ontario	river, high in clay	½ ppm added to clarifier, alum added in preceding tank	Improved clarity, reduced alum, elimination of silica
Far West	river, low in suspended & dissolved solids	0.1 ppm added after clarifier just before filters	Improved clarity & filter operation, elimination of silica
Southwest	brine, high in Ca.	0.15 ppm added to secondary mixing zone of clarifier	Improved clarity, increased throughput, reduced lime & $Fe_2(SO_4)_3$
Midwest	well water, hard	¼ ppm added to softener, lime and $NaAlO_2$ added in preceding tank	Reduced turbidity, less $NaAlO_2$, more stable against post-precipitation of $CaCO_3$
Southeast	river water, colored, turbid	¼ ppm added to clarifier, alum & lime added in preceding tank	Improved clarity, reduced color



EDWARD FORGED STEEL BLOW-OFF VALVES

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Edward Drop Forged Blow-off Valves

. . . the first—and still the newest!

Fifty years ago, when boilers operated at 250 lb sp the first really efficient means of blowing-down was with "new" Edward blow-off valves. Today, with pressure in the 1800-2600 lb range and with water temperatures sometimes exceeding 600 F, corresponding improvements in Edward blow-off valves have been effected. For example, today all Edward blow-off valves have integral Stellite seats and Impactor* easy closing handles.

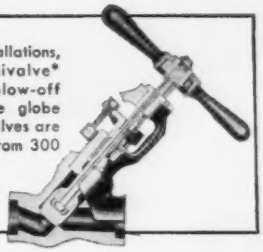
All over the world, high temperature-pressure steam power stations rely on these Rockwell-built Edward blow-off valves. The reasons are basic. Edward valves are simple and rugged in design, with no "trick construction." They operate easily, stay tight, need very little maintenance. If parts replacement is ever necessary, repairs are easier and less expensive than with any comparable valve.

The ASME Power Boiler Code requires steel valves wherever boiler drum pressure is above 200 psi . . . but, because blow-off service is severe at any pressure, operators of lower-pressure plants also have found it most economical to standardize on Edward valves.

Catalog 12-D2 tells the full story.

Recommended practice: Open valve *nearer* boiler first. Then slowly open other valve. After blow-off, close second valve first; then valve nearer boiler. This places greatest wear on blowing valve, assures a tight valve next to boiler, facilitates repair without a boiler shut-down.

Popular for high pressure installations, the Edward welded-bonnet Univalve* meets Code requirements for blow-off service and is ideal all-purpose globe valve as well. Edward blow-off valves are available in all pressure classes from 300 lb to 2500 lb in angle or straight-way styles, with flanged or welding ends.



Premium Features of Edward Blow-off Valves

- **INTEGRAL SEAT** of chromium-cobalt-tungsten alloy. Applied directly to body in a continuous ring, then machined in same set-up with bonnet guide bore for perfect alignment. Highly resistant to abrasion and corrosion.
- **HARD-FACED DISK**—Stellited for maximum resistance to abrasion and corrosion. Edward swivel-disk construction allows stem to lift vertically away from seat. No grinding or galling.
- **POSITIVE BACKSEAT** isolates packing from the high temperature zone. Line-contact backseat seals EValpak* valve packing from line pressure, permits repacking under pressure.
- **IMPACTOR HANDLE**, an Edward exclusive, is standard equipment. Several times more effective than ordinary handles or handwheels in opening or closing valves.

EDWARD VALVES, INC.

1230 West 145th Street, East Chicago, Indiana

Subsidiary of

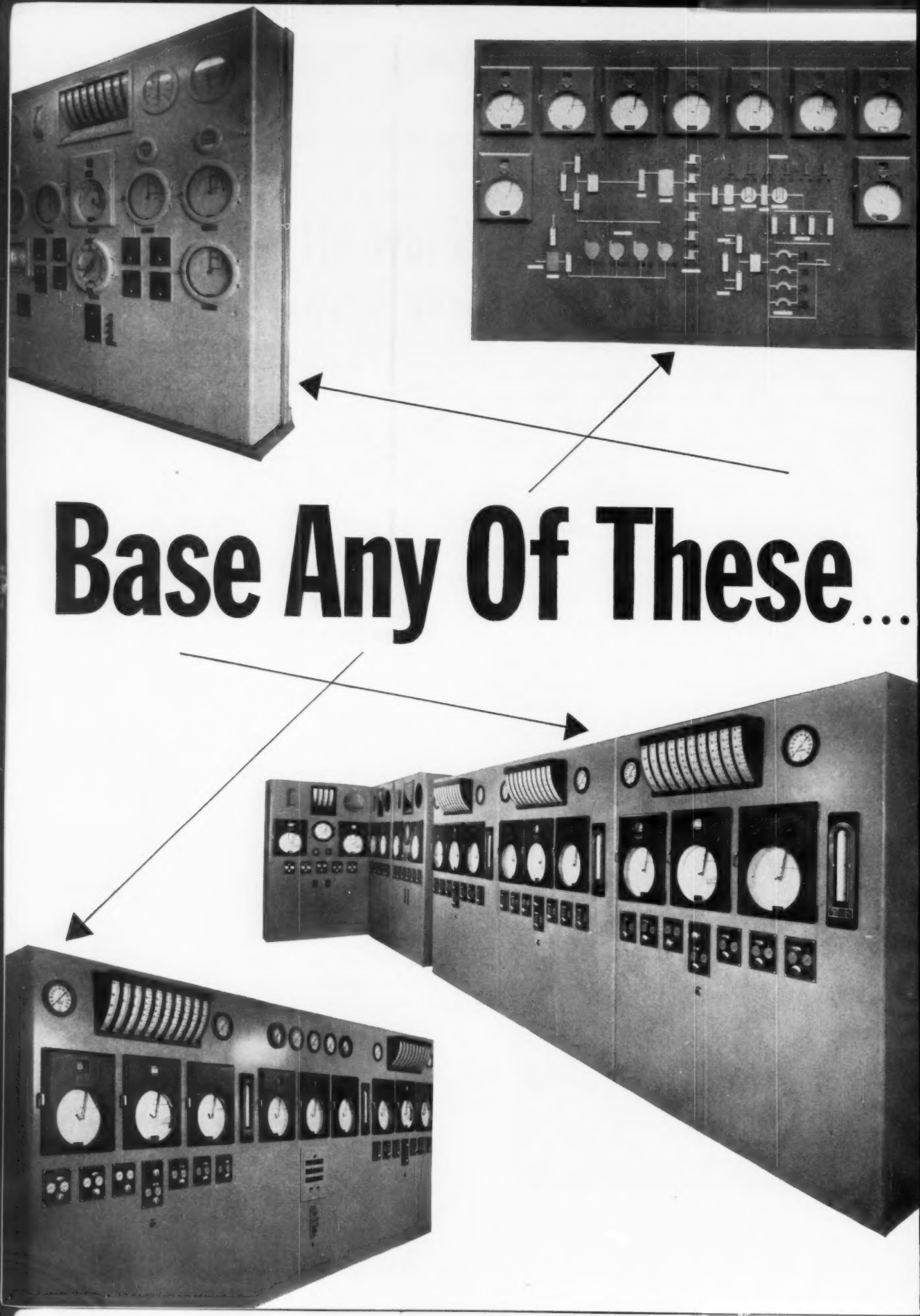
ROCKWELL MANUFACTURING COMPANY

Represented in Canada by

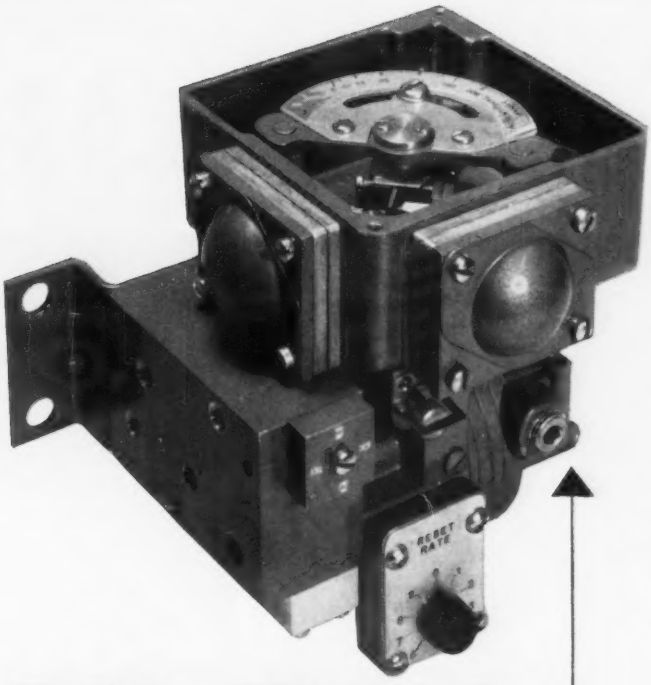
LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

*T. M. Reg. U. S. Pat Off.



Base Any Of These...



.....ON THIS

For accurate, efficient, dependable control systems— new Rockwell-Built REPUBLIC TYPE "VC" PNEUMATIC CONTROLLER

Here is an all purpose null-balance-vector controller for use with any pneumatic transmitter. Its proportional band ranges from 2% to 500% *without changing parts*, for quick adaptation to changes in process requirements. Especially important in high-precision control, Republic's Type VC has exceptional sensitivity and a narrow dead band (less than 0.05%). Its high capacity non-bleed pneumatic amplifier consumes little air, keeps output ample. A selector block permits reverse or direct action. Local or remote pneumatic set point optional.

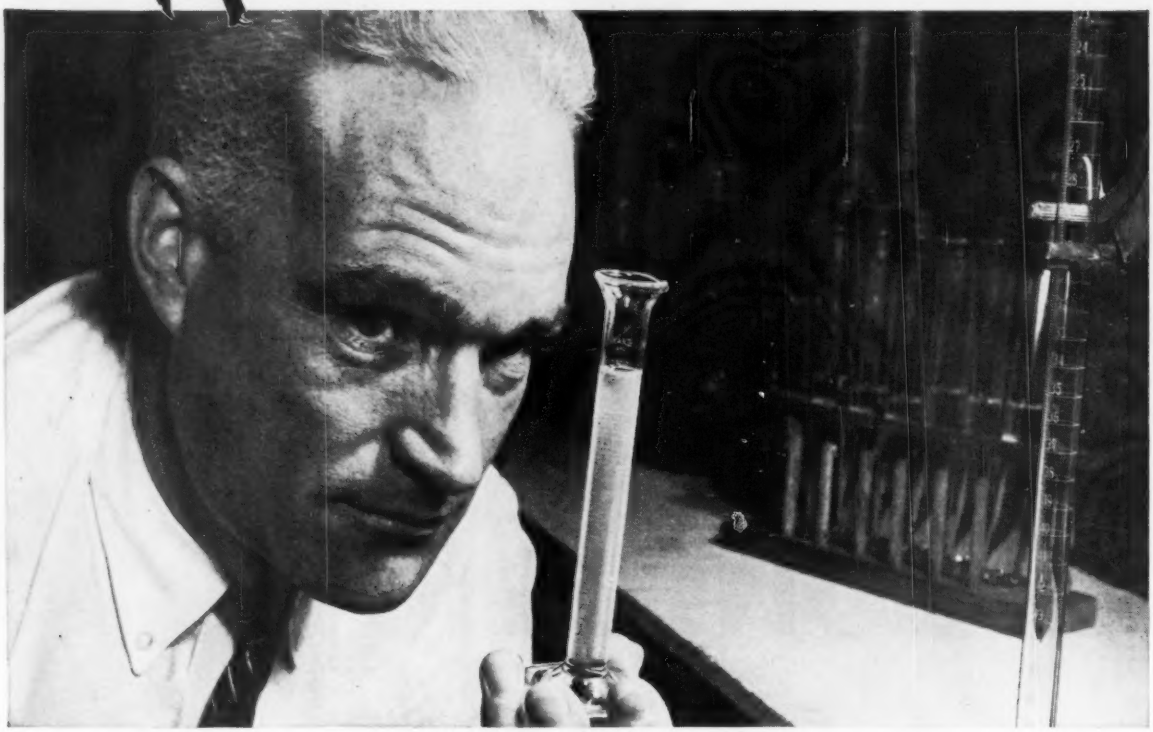
Companion instruments—using an identical null-balance-vector "heart"—include differential pressure, temperature and pressure transmitters . . . ratio, totalizing, multiplying, squaring and square - root - extracting relays. Many parts are interchangeable among the instruments in this "family". Besides reducing spare parts inventory, the similarity of components simplifies the task of training personnel.

Let a Republic engineer show you how these instruments can help to achieve accurate, efficient, dependable control systems. Sales offices in principal cities throughout the U.S. and Canada. Write to Republic Flow Meters Company (subsidiary of Rockwell Manufacturing Company), 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

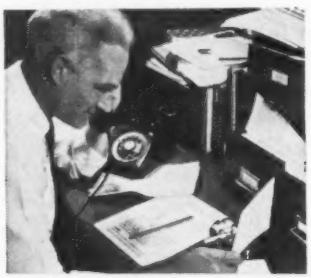
BRIDGEPORT "T" MEN* IN ACTION

**Technical Service Men*



The Case of the Acid Assailant

Where's the Culprit? Field spot tests of water samples give revealing clues as to cause of corrosion.



Case Solved. Initial recommendations go out to customers immediately and are followed by a detailed written report.

It was an ordinary afternoon in the Corrosion Lab when a sample of raw cooling water and a corroded condenser tube arrived from a midwest chemical company. Accompanying the evidence was a letter of explanation and a completed Technical Service corrosion questionnaire. The customer wanted help. Bridgeport "T" men swung into action.

The water sample was analyzed. It checked out against the original sample taken when Bridgeport tubes were first installed. Still no conclusive evidence of corrosive media was found in the water. Yet, examination of the tubes revealed them to be corroded both by acid and an abrasive.

The Bridgeport "T" Man visited the plant site and retraced the case step by step.

The first break came when a spot check was made of water taken directly from the cooling tower. A significant acid content was noted. Further on-the-spot examination showed that gas and fly ash from the plant smokestack were carried by prevailing winds over the cooling tower and deposited in large amounts in the tower. Closer examination of the cooling tower uncovered acid-forming sludge and abrasive fly ash in suspension.

The Bridgeport "T" Man, in an extensive report of his findings, recommended corrective measures. Company adopted recommendations. Tubes saved. Case closed.

This is a typical case from the files of Bridgeport Technical Service, a group set up to help Bridgeport customers get maximum life and service from their power and process equipment.

For the best service and advice on condenser or heat exchanger tubes call your nearest Bridgeport Sales Office today.

BRIDGEPORT CONDENSER TUBES

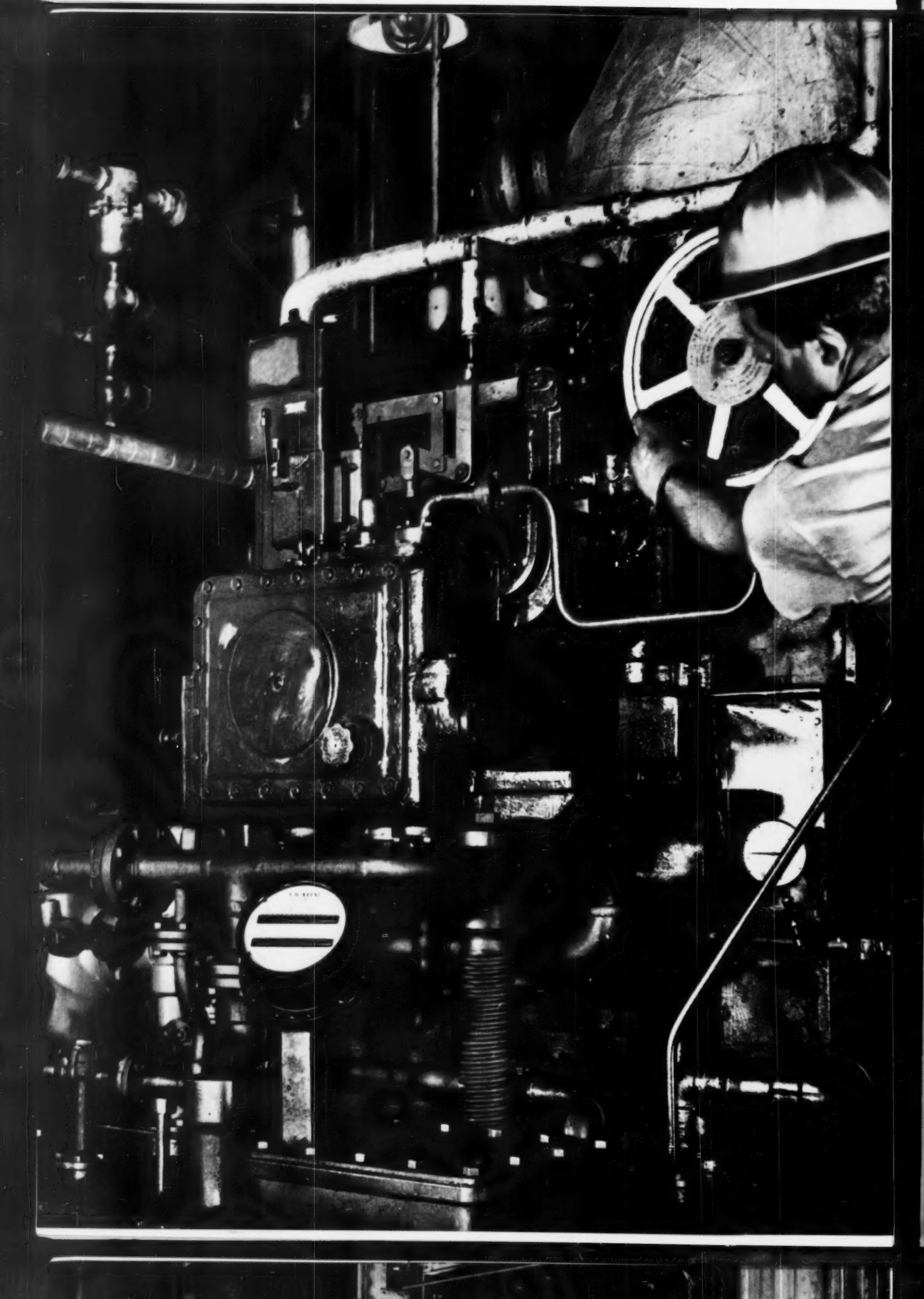
BRASS Bridgeport CO.

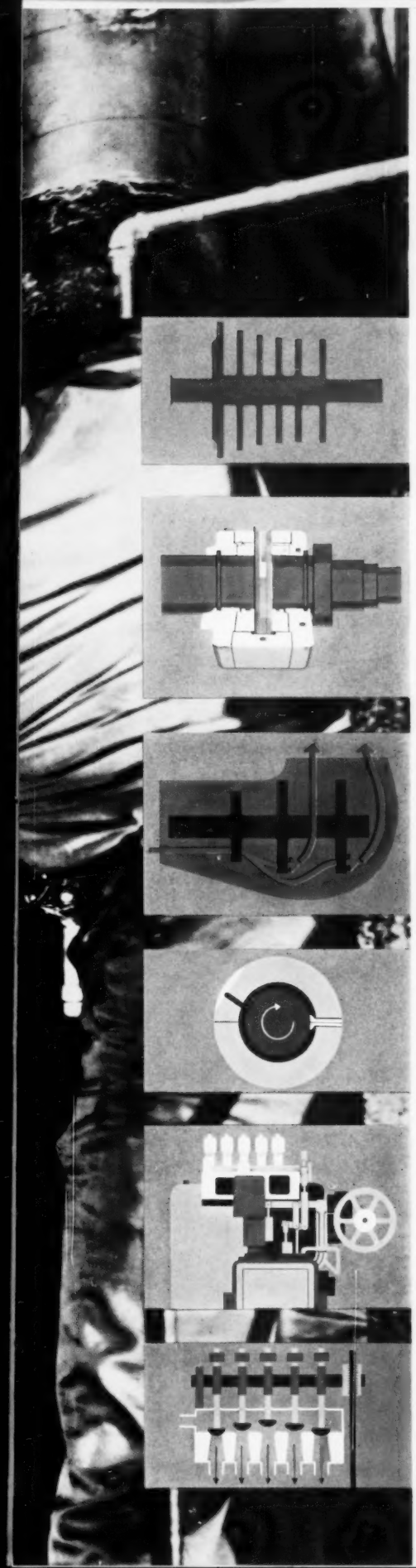
Bridgeport Brass Company, Bridgeport 2, Connecticut

Sales Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal

HOW TO SAVE MONEY BY SPENDING IT!

PAY EXTRA NOW FOR 6 BASIC RELIABILITY FEATURES OF WORTHINGTON HIGH-SPEED TURBINES AND AVOID THE EXCESSIVE COSTS OF DOWN-TIME LATER





Worthington High-Speed Turbines cost more to build, are used more, are worth more

(these 6 reliability facts are some of the reasons why)

Reliability Fact #1

SOLID ROTORS keep wheel stresses well within safety margins. Where needed, wheels forged integral with the shaft are used to meet the demands of modern high speeds. Solid rotor construction, a sure method of holding wheels on the shaft, provides a more rugged conservative design. Solid rotor also decreases length of turbine, thus simplifying critical speed problems and adding to efficiency.

Reliability Fact #2

KINGSBURY-TYPE THRUST BEARINGS withstand heavy thrust loads with small friction loss and low rate of wear. Bearings have babbitted surfaced multi-segment shoes that pivot on hardened buttons. This pivoting action forms a wedge-shaped oil film between the rotating thrust collar and the shoe bearing surface. This has a cushioning effect in case of unusual shock loads in either direction. The thrust load is automatically distributed equally to the several shoes thereby maintaining internal alignment as well as holding the rotor in its axial position.

Reliability Fact #3

DOUBLE-FLOW exhaust construction on Worthington turbines reduces operating stress and increases efficiency in the handling of large volumes of steam at high speeds. Steam is divided ahead of the last stage and directed through separate rows of revolving blades before leaving via a common exhaust. Double-flow exhaust construction allows reduction in last-stage wheel size and blade length, which reduces wheel and blade stress and makes possible a simplified blade design. This permits improved nozzling with consequent efficiency increase.

Reliability Fact #4

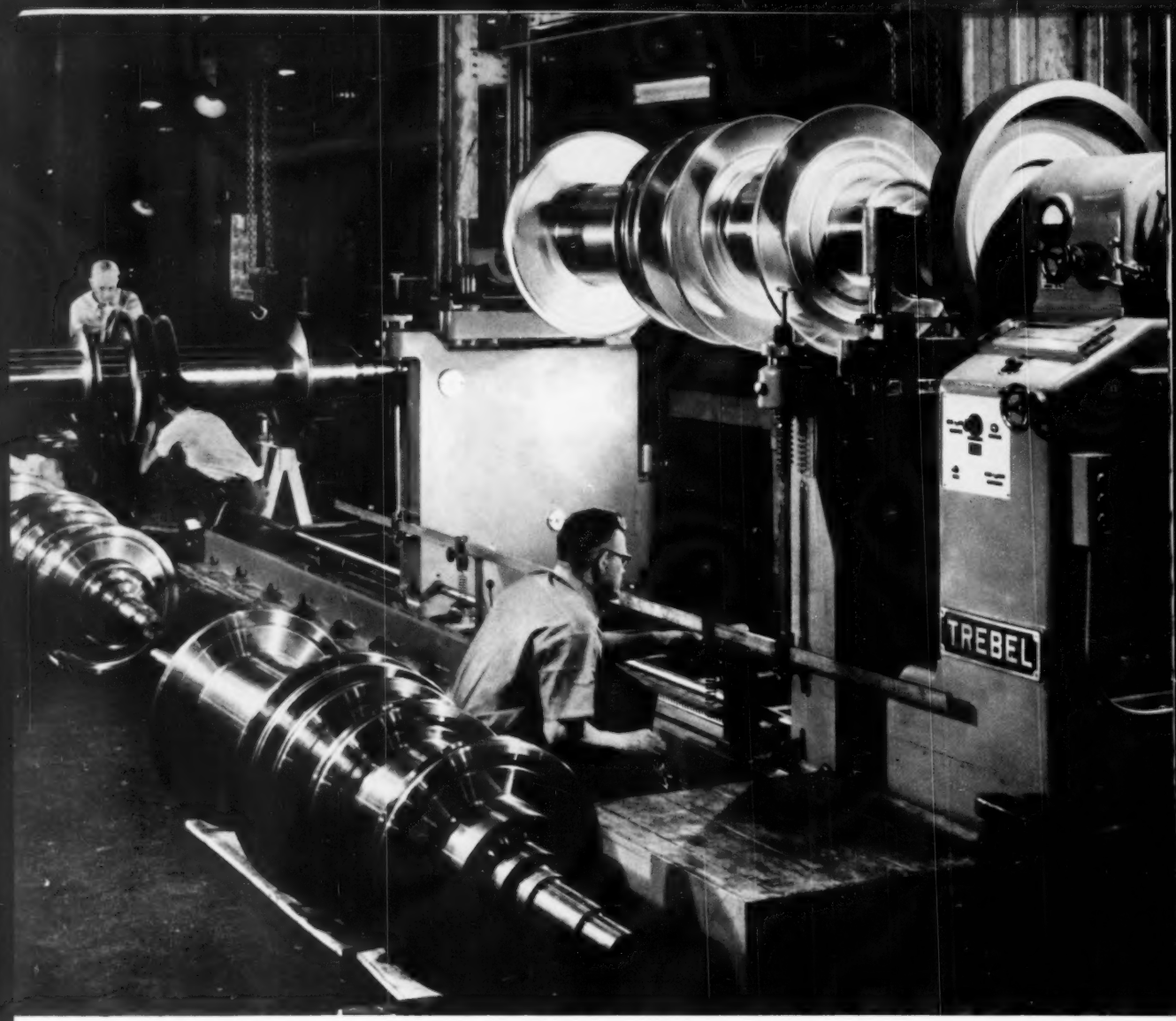
ANTI-OIL-WHIP BEARINGS are standard on Worthington high-speed turbines. A dam in the upper half of the bearing builds up a pressure pad of oil during operation. The pressure creates a downward force on the journal holding it firm in the bearing, thus keeping vibration to a minimum. Anti-oil-whip design increases life, cuts maintenance expense on bearings.

Reliability Fact #5

SENSITIVE SPEED GOVERNING SYSTEM with integral air motor combines extremely close regulation with a broad range of speed adjustment. Governor takes air impulses from an outside controller to vary speed of turbine in accordance with controller's impulse. Sensitive governor is capable of maintaining the output from the compressor substantially constant. Regardless of changes in load or steam conditions, the turbine is always under control of the speed governor, governing at any speed for which the air motor is set.

Reliability Fact #6

MULTI-VALVE AUTOMATIC NOZZLE CONTROL assures most economical operation of the turbine at all loads. Each valve automatically controls the admission of steam to a separate group of nozzles, and is operated by an independent cam mounted on a camshaft. The cams are shaped to give any desired rate of opening. The entire mechanism is mechanical, positive, and far superior to other lower-cost designs.



Balancing rotor for a 6,000 hp Worthington high-speed turbine.

THE MEANING OF LEADERSHIP

Long, trouble-free life of Worthington high-speed turbines stems from two primary sources. One: the multiple achievements of Worthington engineers. Two: the wide variety of tests to which machines are subjected before shipment to customer. Worthington, for example, is the only manufacturer that load-tests all multi-stage turbines. In this process, the turbine is coupled to a water brake so that its precise behavior under actual performance conditions can be predicted. Only when the turbine has passed this — and many other exacting tests — is it approved for shipment. This infinite attention to detail, this painstaking insistence upon perfection, explains why Worthington is today the nation's undisputed leader in high-speed turbine installations.

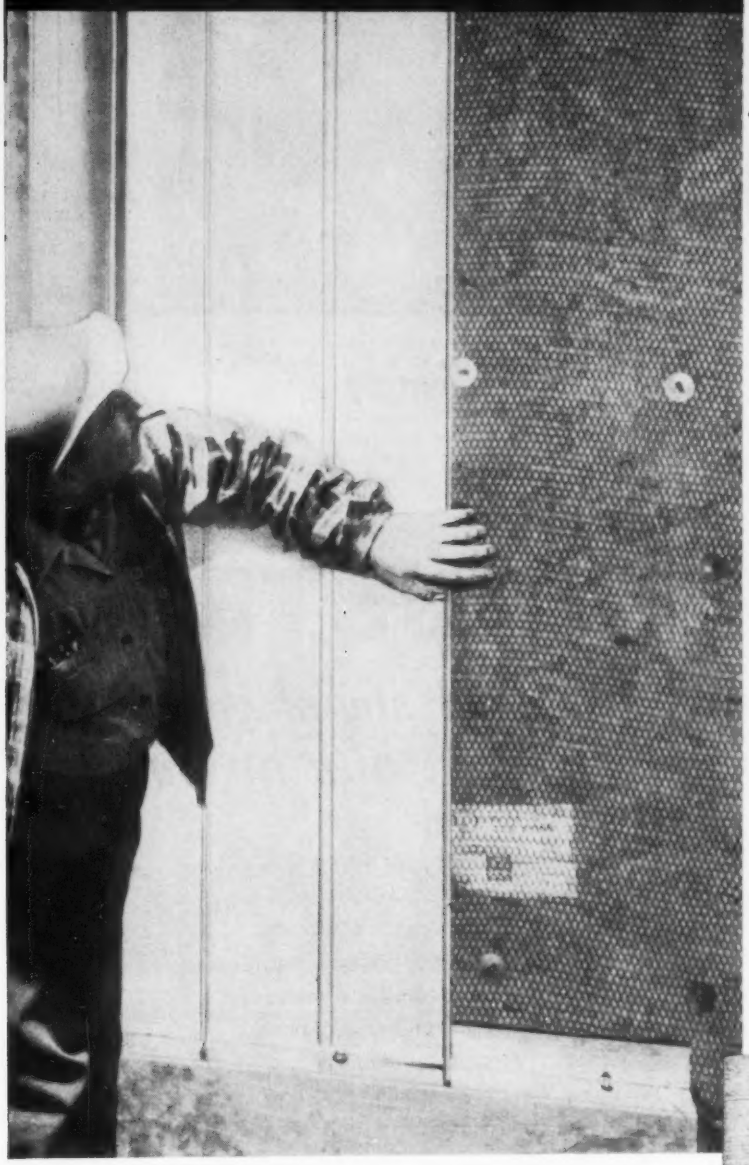
48-2

WORTHINGTON

WORTHINGTON CORPORATION, HARRISON, NEW JERSEY

DETROIT EDISON COMPANY
Wraps up an Insulation Problem . . . with 4 inch

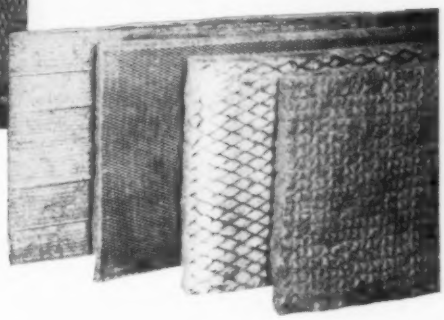
BALDWIN-HILL
Spun Mineral Fiber
BLANKETS



When Detroit Edison wanted to insulate the boiler water walls of their River Rouge power plant, they selected B-H spun mineral fiber Blankets, 4″ thick, to obtain the required thermal efficiency.

B-H Blankets, size 2′ x 8′, were particularly adaptable to covering the 8′ high areas of the boiler skin casing. These blankets are B-H Style No. 2A with 1″ wire mesh on the inner face and expanded metal lath on the outside. They were impaled over studs welded to the boiler skin casing and laced tightly together to form an unbroken layer of insulation. The blankets were later protected with a shell of aluminized sheet metal panels.

B-H Mono-Block also was used to insulate all heated fan housings as well as air and gas ducts; all joints were pointed with B-H Improved Super Powerhouse Cement.



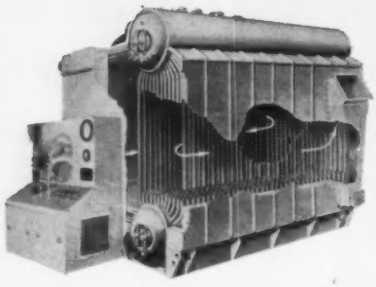
BALDWIN-HILL
Company

109 Breunig Ave., Trenton 2, N. J.

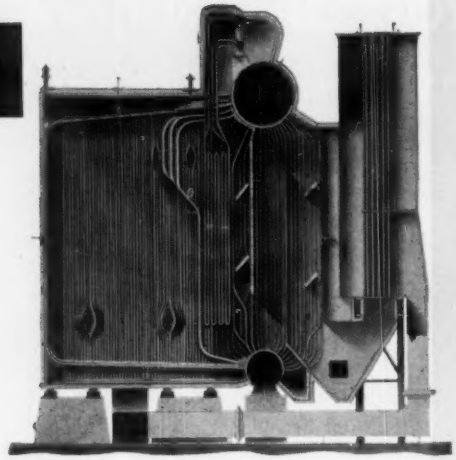
Kalamazoo, Mich. . . . Huntington, Ind. . . . Temple, Tex.

For more information on these products as well as other B-H Insulations, write for 1958 catalog—or see it in Sweet's Plant Engineering File.

OIL AND GAS FIRED BOILERS
(standardized designs)



C-E Package Boiler, Type VP — Completely shop assembled . . . available in 14 sizes from 4,000 to 50,000 lb of steam per hr capacity . . . pressures to 500 psi. Available with integral console control panel. This unit contains more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type.



C-E Vertical-Unit Boiler, Type VU-55 — Available in six sizes . . . capacities from 50,000 to 120,000 lb of steam per hour . . . designed for three pressure ranges, 250 psi, 500 psi and 750 psi, and steam temperatures up to 750 F. Equipped with tangential burners. 60-inch steam drum assures generous water capacity and steam reservoir space. Tangent tube waterwalls offer complete furnace protection, minimizing maintenance.

MODERN INDUSTRIAL

C-E offers the most advanced steam generating in any size . . . for any fuel . . . with any method

All the designs pictured here have something in common. All are evolved from a basic design concept — a 2-drum, vertical boiler with fully water-cooled furnace in front of the boiler proper — a design which Combustion Engineering originated more than 30 years ago and which has enjoyed the widest acceptance.

All are fully integrated designs comprising boiler, furnace, fuel-burning and, where required, superheat and heat-recovery equipment, coordinated into a smoothly functioning unit.

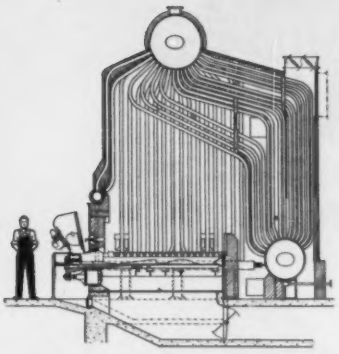
All have benefited from C-E's experience in meeting the most exacting standards in steam generation — those of the electric utility industry for which C-E is currently designing and building boilers which will set tomorrow's standards of capacity, pressure and temperature.

All have demonstrated — in many installations — high standards of performance . . . economy, reliability and suitability for the particular fuel and operating conditions for which they were selected.

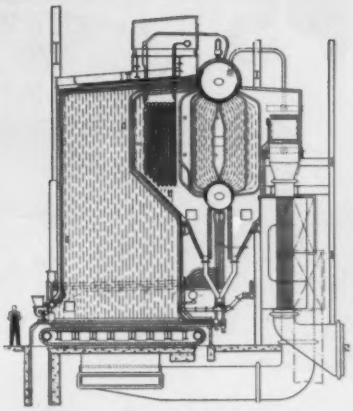
So — no matter what combination of conditions prevail at your plant, Combustion has a boiler unit that can meet your requirement, exactly — and economically. We'd like to discuss it with you and your consultants.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

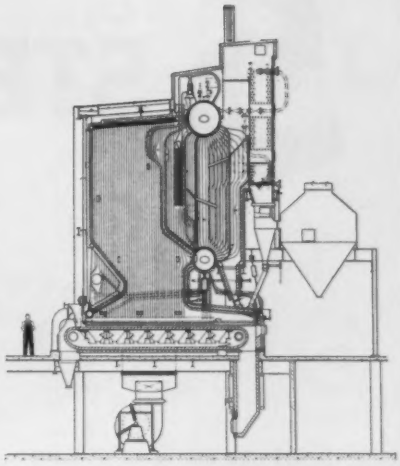
STOKER FIRED BOILERS*



C-E Vertical-Unit Boiler, Type VU-10 — fired by a C-E Underfeed Stoker, Type E — VU-10 Boilers are available for capacities from 10,000 to 60,000 lb of steam per hr with pressures to 475 psi; superheat to 200 F in larger sizes. Also can be equipped with C-E Spreader Stokers, dump grate type.



C-E Vertical-Unit Boiler, Type VU-40 — fired by C-E Spreader Stoker, continuous discharge type — A baffleless boiler with capacities ranging up to about 300,000 lb of steam per hr, with pressures to 1,200 psi; temperatures to 950 F.

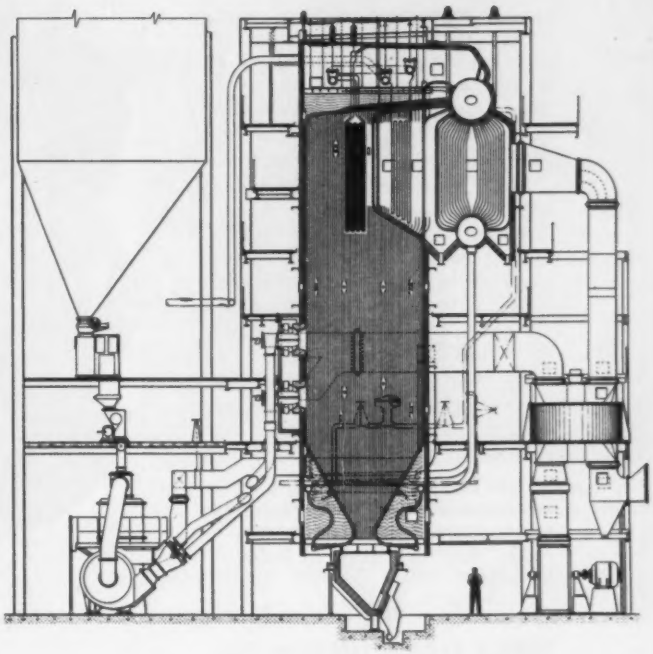


C-E Vertical-Unit Boiler, Type VU-50 — fired by C-E Traveling Grate Stoker — Units of this design are suitable for capacities up to about 150,000 lb of steam per hr; pressures to 1,200 psi; temperatures to 950 F.

BOILERS

equipment of firing

PULVERIZED COAL FIRED BOILERS*



C-E Vertical-Unit Boiler, Type VU-40 — using C-E Raymond Bowl Mills and Horizontal Burners — Capacities up to 600,000 lb of steam per hr, pressures to 1,200 psi, temperatures to 950 F.

These drawings are a few examples of the many units available for coal firing: all are readily adaptable to oil or gas firing.

COMBUSTION ENGINEERING

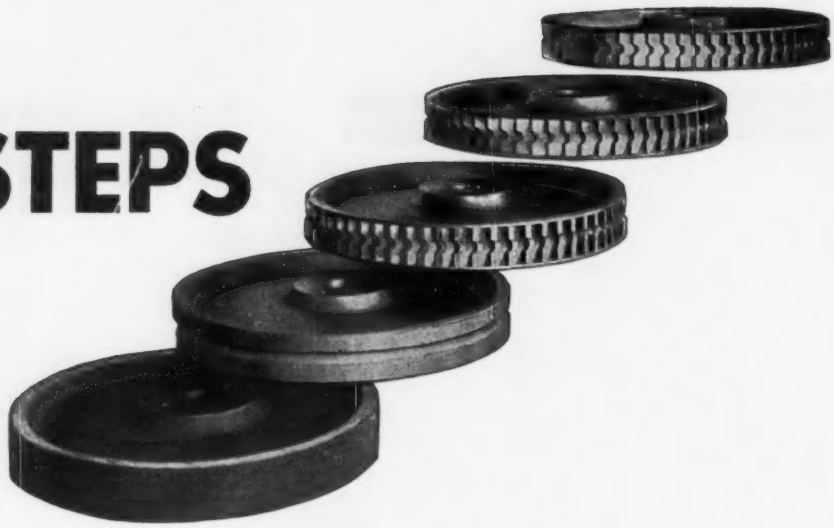
Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

C-139

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

5 STEPS



in making an almost indestructible turbine

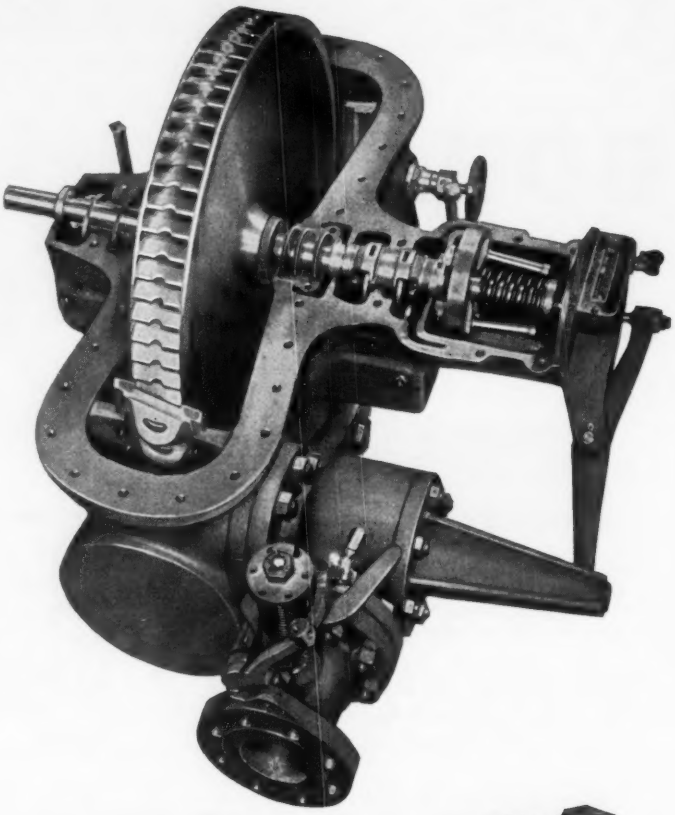
The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

The Terry solid-wheel turbine is an extremely reliable piece of equipment. Write for details—today. Ask for a copy of bulletin S-116.

THE
TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.



TERRY

TT-1204

Values You Can't Specify

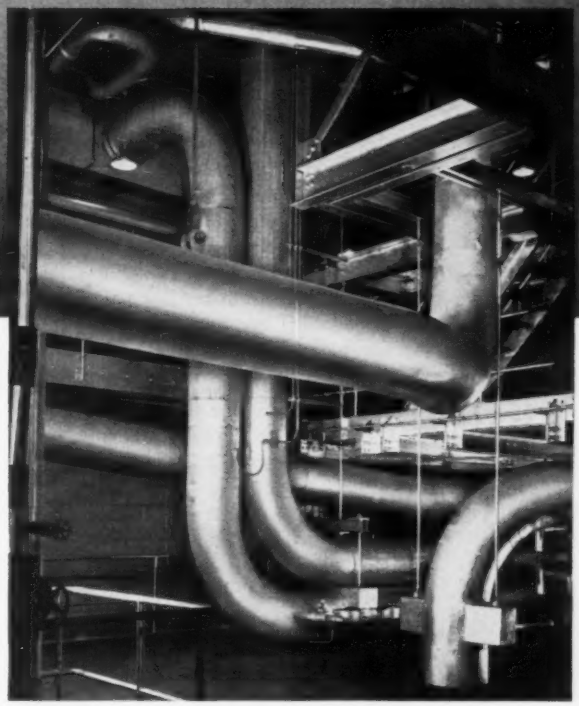
You Get Them in MIDWEST PIPING

In the fabrication and erection of every high pressure and/or high temperature piping installation, there are intangibles important to the success of the job . . . things that cannot be spelled out in the specifications but are essential to getting superior piping at an economical price.

Important among these is the experience of the fabricating and construction organization . . . experience on all kinds of projects so that the possibilities and limitations of all piping materials are well understood. Midwest has fabricated and erected the piping on many critical jobs . . . including numerous atomic energy projects and Kyger Creek (the largest steam power plant ever handled completely by one piping contractor).

Another is a questioning attitude . . . a frame of mind that habitually asks (before the job is placed in the shop for fabrication): "Have the pre-fabricated sub-assemblies been so planned that the field work is minimized and simplified as much as possible?" Highly skilled Midwest piping engineers carefully analyze every job with this question in mind.

For power plant or process, the customer gets the most for his money when he buys Midwest Piping.



Main steam piping at Kyger Creek Plant which has a capacity of 1,075,000 kw and is the largest power plant piping contract (combining fabrication and erection) ever performed by a single contractor.

MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Mo. (P. O. Box 433)

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

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Los Angeles 33—520 Anderson St. • Miami 34—2103 Le Jeune Rd.
New York 7—50 Church St. • Pittsburgh 19, Pa.—437 Grant St.
San Francisco 11—420 Market St.
St. Louis 4, Mo.—1450 South Second St.
Tulsa—1640 E. 21st St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

7670

MIDWEST PIPING FABRICATION AND CONSTRUCTION

Offer you many advantages

What are your needs for

YARWAY COLOR-PORT WATER LEVEL GAGE

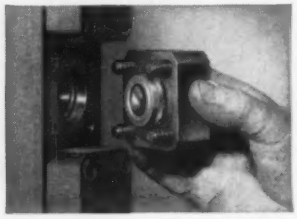
two-color readings
low maintenance
increased availability

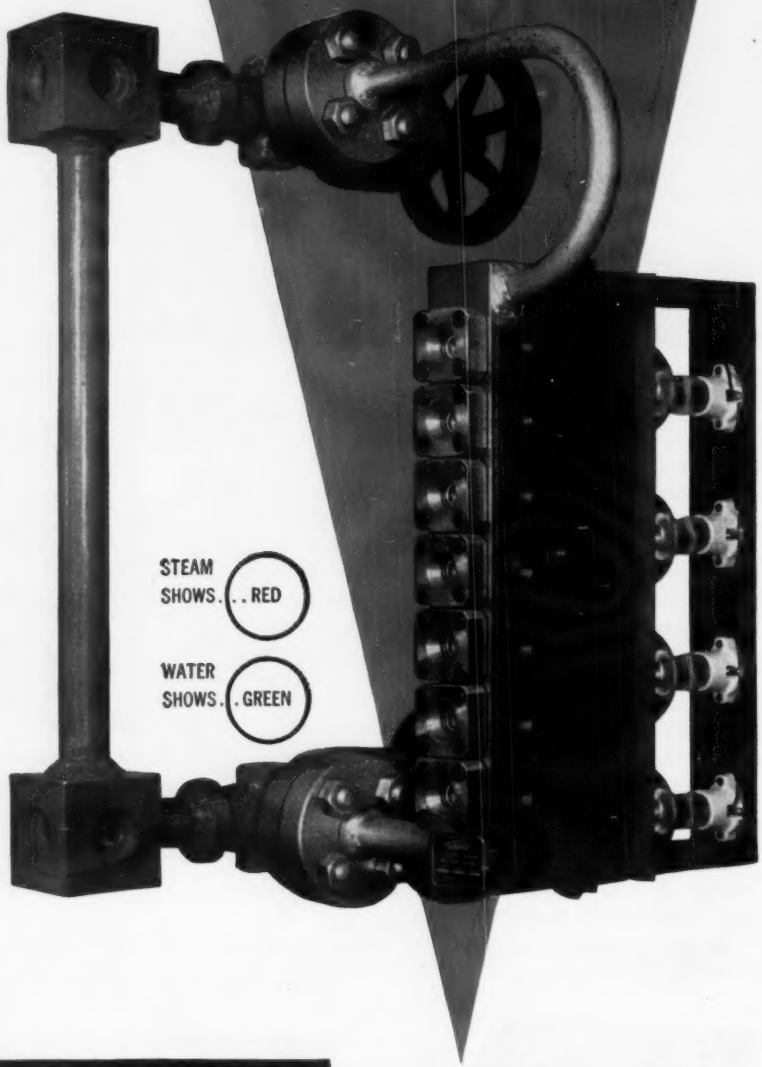
You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.



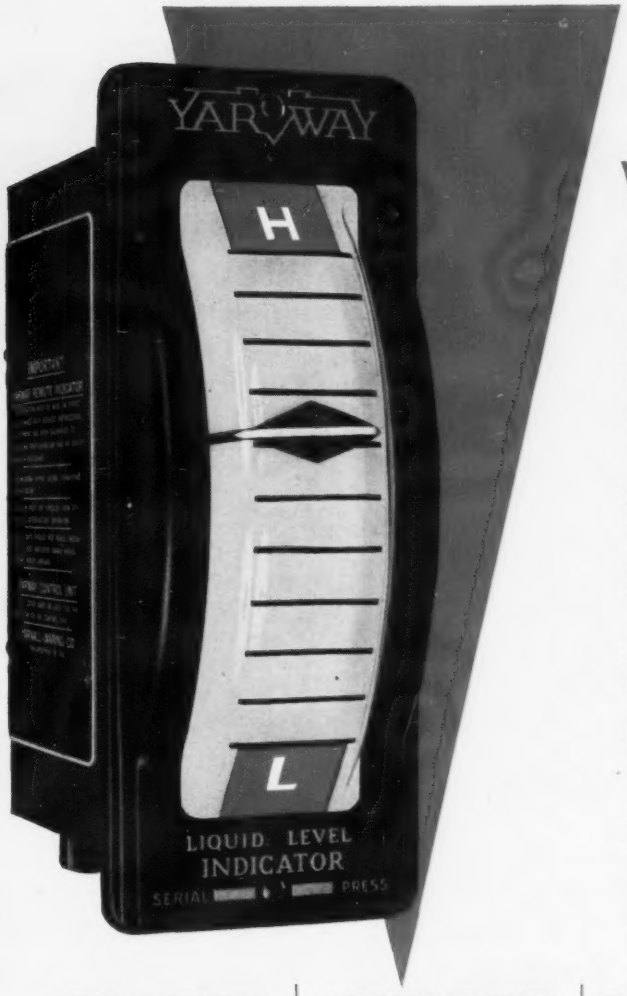


Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY COLOR-PORT . . . *a good way to specify high pressure water gages*

boiler water level indication ?



YARWAY REMOTE LIQUID LEVEL INDICATORS

Boiler water levels and other liquid levels requiring remote indication can be handled completely by a Yarway system.

Heart of the system is the Yarway Remote Liquid Level Indicator that gives instant, accurate readings because the mechanism is operated by the boiler water or other liquid itself. The pointer mechanism is never under pressure. Clear, "wide vision" face permits easy readings from any angle.

The Yarway Indicator conforms with A.S.M.E. Boiler Code Committee ruling (Case #1155) permitting two independent remote level indicators of compensated manometric type to replace one of two required gage glasses for boiler pressures 900 psi and above.

Electronic Secondary Indicators can be added at any point in the plant. Remote Hi-Lo Alarm Signals (lights and/or horns) can be connected for additional safety.

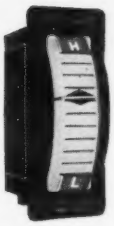
Primary indicators fully compensated for every pressure change in boiler also available.

For permanent record of changing levels, the Yarway Hi-Lo-Graph Recorder can be furnished.

Over 10,000 Yarway Remote Indicators have already been installed. For full details, write for Yarway Bulletin WG-1824.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

FULLY COMPENSATED INDICATORS



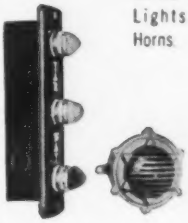
for completely accurate indication under every boiler operating condition

ELECTRONIC SECONDARY INDICATORS

To supply additional indication at any point without pressure connections.

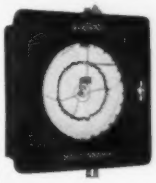
REMOTE SIGNALS

Hi-Lo Alarms Lights and/or Horns



RECORDERS

To provide permanent 24-hour record of liquid levels.

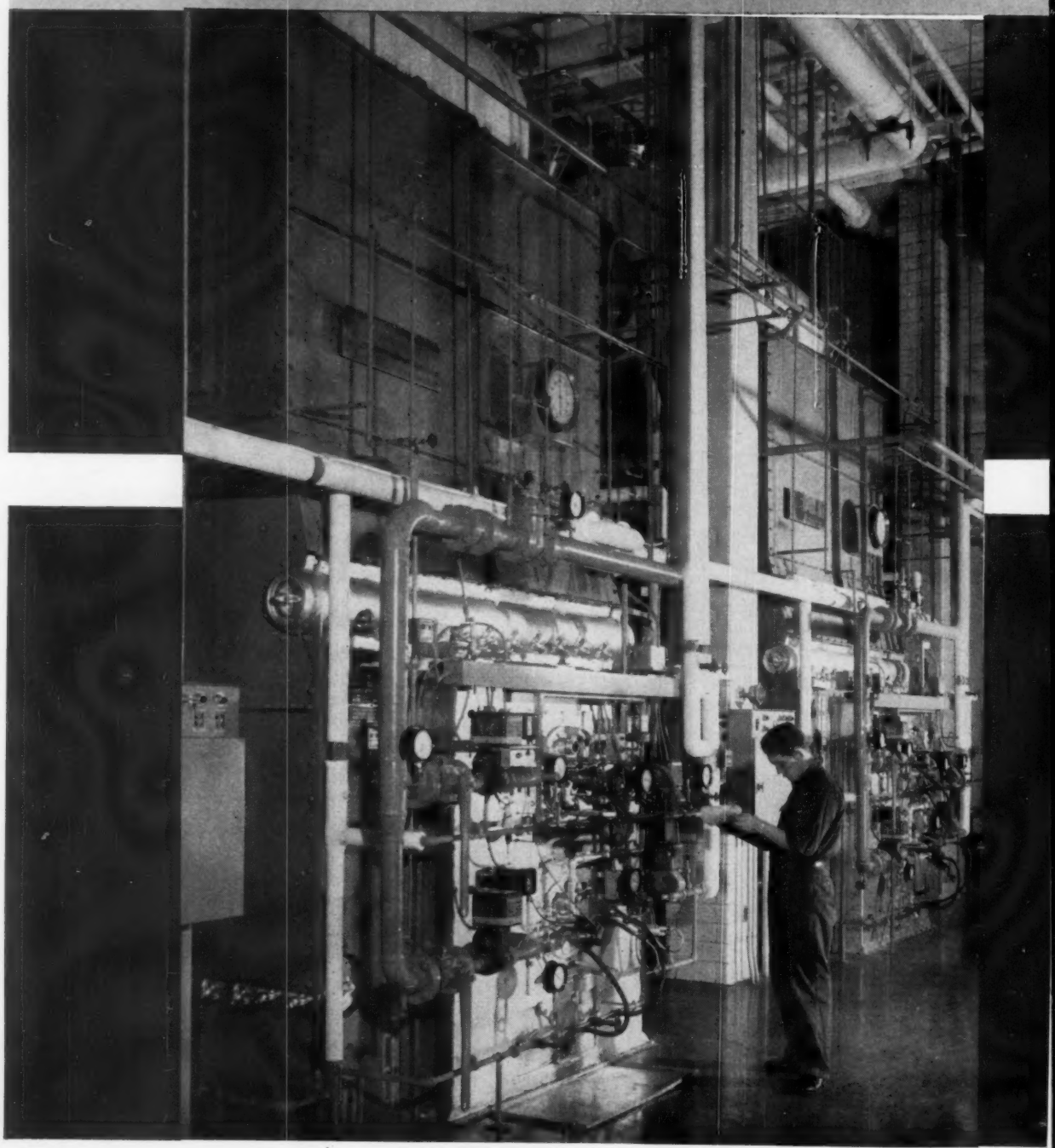


YARWAY

. . . a good way to specify remote liquid level indicators

WICKES TYPE S-1AL

HEAT ONE OF AMERICA'S



STEAM GENERATORS
MOST MODERN BUILDINGS

CONNECTICUT GENERAL LIFE INSURANCE CO., Bloomfield, Conn.

ARCHITECTS:
Skidmore, Owings & Merrill

GENERAL CONTRACTOR:
Turner Construction Co.

MECHANICAL CONTRACTOR:
Kerby Saunders, Inc.

A recent exhibit at the National Gallery features 10 of America's most modern buildings. The American Institute of Architects, on the occasion of its Centennial, included in the exhibit the new home office of the Connecticut General Life Insurance Company in suburban Hartford, which is equipped with Wickes boilers. This spacious, sun-flooded building of steel and glass, is nearly a modern city in itself, for it houses not only the complete office system, but includes employee lounges, game rooms, medical department, mailrooms, auditorium, bowling alleys, barber and beauty shops as well.

For the heating system in this mammoth structure, engineers chose to install two Wickes type S-1AL steam generators equipped with both oil and gas burners. In addition to general heating, the steam generators provide power to operate the refrigeration machines and a snow-melting system on the truck ramp. The boilers each have 3700 sq. ft. of heating surface, and were designed for a maximum continuous load of 27,500 pounds of steam per hour at 200 PSIG.

Bulletin No. 55-1 gives complete facts on Wickes products. New engineering bulletins on Type-S and Type-A Steam Generators are also available on request.

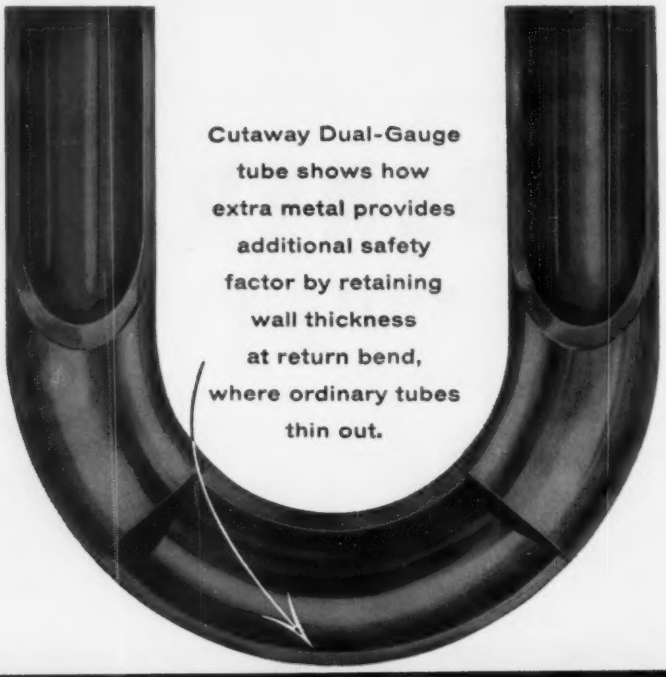
WICKES

WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

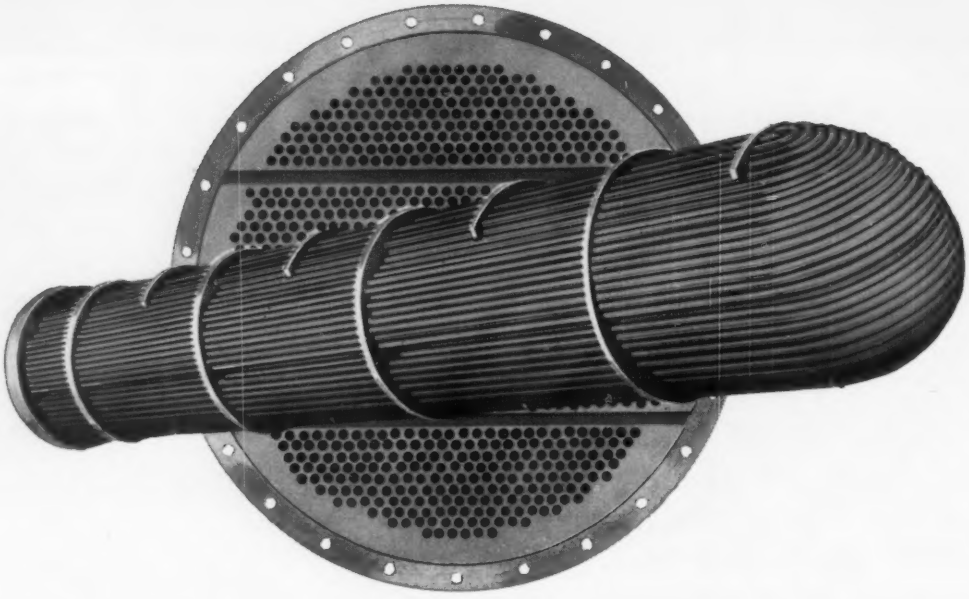
RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Boston • Chicago • Cleveland • Dallas • Denver • Detroit • Houston Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • New Orleans • Portland, Ore. • Saginaw San Francisco • Springfield, Ill. • Tulsa

168



Specify

DUAL-GAUGE



First for Lasting Quality—from Mine to Market!

To keep tubes uniformly strong
in condensers, feed water heaters,
heat exchangers and similar equipment...

PHELPS DODGE

TUBING!

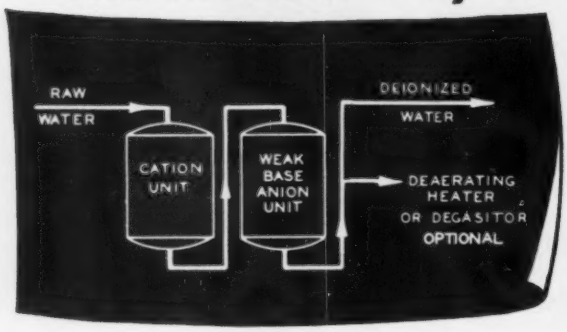
- Provides heavier wall thickness:
  - **a.** At one or more points in tube length to compensate for thinning on outer portions of return bends.
  - **b.** At points of support.
  - **c.** At tube ends to meet special requirements.
- Produced in all standard sizes or manufactured to the particular design requirements of individual customers.
- Available in Cupro-Nickel, Red Brass, Aluminum Brass, Admiralty metal and Muntz metal.

PHELPS DODGE · PD · COPPER PRODUCTS CORPORATION · MINE TO MARKET · REG. U.S. PAT. OFF.

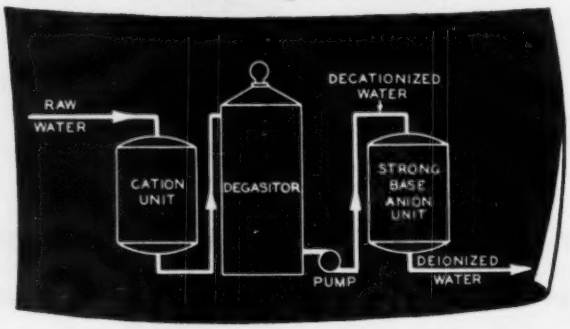
PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass. Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

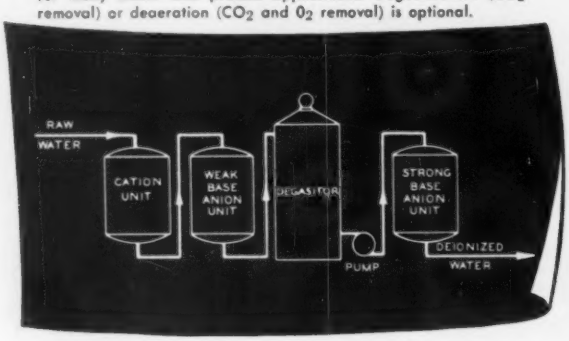
The modern way to solve water problems



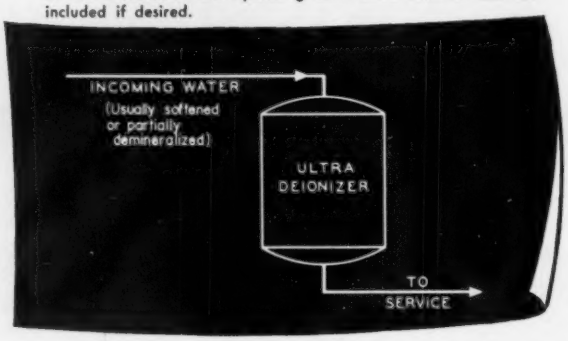
Delivers deionized water quite low in dissolved solids and suitable for many boiler and process applications. Degasification (CO_2 removal) or deaeration (CO_2 and O_2 removal) is optional.



Delivers high quality mineral-free water and eliminates CO_2 at low investment and operating cost. Silica removal can be included if desired.



Used where water high in quality and free of CO_2 and silica is desired. A most economical system for high-bicarbonate waters.



Mixed-bed unit produces deionized water of highest known chemical purity. Removes CO_2 and silica. Used alone and as a "polishing" unit.

ELGIN Deionizers accurately "tailored" to fit specific needs

Where can you find the one BEST solution to a specific water conditioning problem? Certainly it must come from an organization like Elgin that knows and offers *every* modern and authoritative approach.

Take, for example, the modern, almost miraculous field of deionization. Four basic systems of deionization are diagramed above. Since countless variations of each are possible, there is no limit to the types of equipment that can be accurately and individually tailored by Elgin to fit any specific requirement.

"Tailored" is the word. It is this accurate tailoring that is behind the Elgin record of cutting costs and stepping up production in plants of all types and sizes, everywhere.

Elgin ion exchangers, which include water softeners, dealkalizers, multi-column and mixed-bed deionizers, are available with manual or automatic controls to fit any feed, process, or general water treating requirement. Other equipment which rounds out the Elgin line is shown below.

Whatever your water treating problem, your nearest Elgin Representative would like to bring our fifty years of experience to bear upon it. Let us put him in touch with you. Or, if you prefer, tell us your conditions and we will send covering bulletins.

ELGIN
WATER CONDITIONING
SINCE 1908

ELGIN SOFTENER CORPORATION
130 N. Grove Avenue, Elgin, Illinois
Representatives in Principal Cities
In Canada: G. F. Sterne & Son Ltd., Brantford

ELGIN SOFTENER CORPORATION
50th Anniversary
1958
WATER CONDITIONING

SOFTENERS | ION EXCHANGERS | FILTERS | DEIONIZERS | DEALKALIZERS | CLARIFIERS | DEGASITORS | DEAERATING HEATERS

Industry Standard for Lower Maintenance Costs

LQ600®

Here's Why: Long accepted valve maintenance costs are a thing of the past in thousands of plants where LQ600's have been installed . . . even in the most severe services where previous valves required repair or replacement after as little as two weeks on the line.

These outstanding savings are made possible by seats and discs of Brinalloy®, a patented Lunkenheimer alloy that is more resistant to wear and corrosion than 500 Brinell Stainless or 1000 Brinell Case-Hardened Stainless Steel.

Add to this the Lunkenheimer exclusive silicon-bronze Stemalloy®, the most durable stem material ever put into a valve, and you have two important reasons why LQ600's have established new low-maintenance standards everywhere they are installed.

For an actual comparison test, call the Lunkenheimer Distributor in your area. He is an expert on valve maintenance costs and will be glad to demonstrate the maintenance-saving benefits you receive when you install LQ600's . . . or write The Lunkenheimer Company, Cincinnati 14, Ohio

LUNKENHEIMER QUALITY

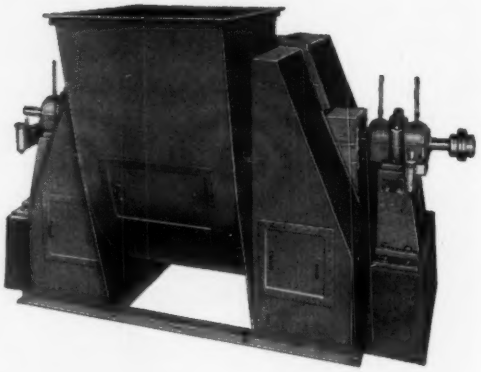
LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

For induced draft...

LOOK what Clarage's new Type DN Dynacurve Fan offers you

1. LOW cost.
2. LOW tip speed.
3. LOW moment of inertia (WR^2).
4. HIGH efficiency.
5. HIGH dynamic conversion.
6. HIGH standards of construction.



Write today for Catalog 905. Clarage Fan Co., Kalamazoo, Mich.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

YEAR 'ROUND BONUS!

You Get More Than Just a Valve When You Buy BS&B's Super 70

Specification of BS&B Super 70 Diaphragm Control Valves on your next job will assure you of getting all of the following:

1. High Quality Product . . . The BS&B Super 70 Diaphragm Control Valve has high efficiency and stability. In addition to thousands of hydraulic flow tests performed in the laboratory, analysis of operating data gathered from Super 70's on stream in customer plants substantiate their excellent performance.

2. Application Engineering . . . Today's complex processing problems require detailed analysis to determine proper instrumentation and control applications . . . accurate control valve sizing. This is a regular service to Super 70 customers.

3. Start-up Assistance . . . After helping customers select the right valve for a specific job, BS&B follows thru by assisting at plant start-up time.

4. Time-saving Scheduled Maintenance . . . With the patented clamp ring—float ring closure, valve maintenance can be done in a fraction of the time required by conventional type valves . . . an economic must in future valve specifications.

Clamp Ring — Float Ring Closure

Flanged — Gasket Closure

BS&B Super 70 Valves are available in either clamp ring—float ring, sealed bonnet or flanged-gasketed body closures. Whichever type you choose, when they're "on stream" you'll *know* that they're exactly right for the job.

Call your nearest BS&B office or representative now to discuss your present and future valve requirements. Or if you prefer, write for detailed information.

OVER 60 YEARS BS&B ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-Q9

7500 East 12th Street

Kansas City 26, Missouri.

Simplicity in steam traps can effect big savings in parts inventory and maintenance time

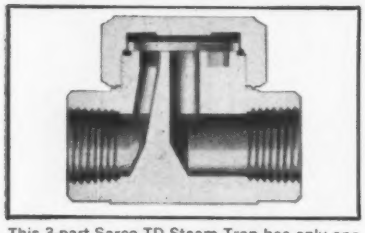
by John W. Ritter, Test Engineer
SARCO Company, Inc.

The function of all steam traps is to release condensate and prevent steam loss. However, the method of trapping can make a great difference in cost and effectiveness.

In the Sarco Thermo-Dynamic Steam Trap, the method is fundamental. Air or condensate entering the trap must flow from the inlet tube, radially across the underside of the disc valve, to the outlet. The space between the inlet tube and the disc forms a nozzle in which the static pressure energy of the incoming fluid is partly changed to velocity across the underside of the disc, with a resultant *decrease* in pressure. (This will be recognized, of course, as the Bernoulli Principle.) Use of this fundamental method means reliability in operation.

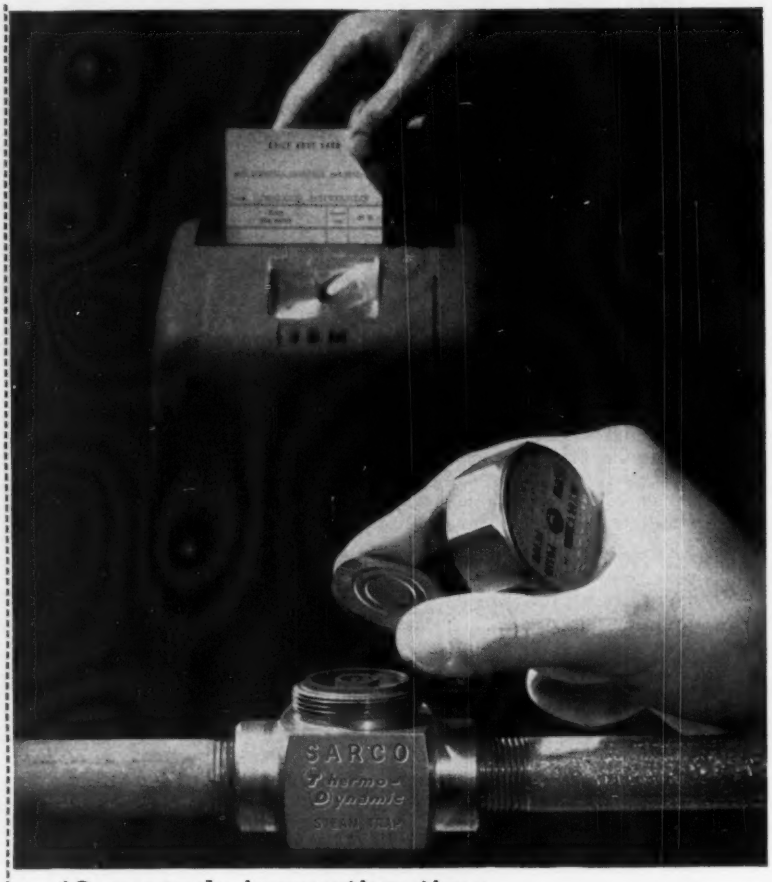
As the high velocity fluid jet strikes the side of the upper chamber, some recompression takes place, so that the pressure above the disc becomes greater than the pressure below it. The pressure reduction under the disc and the pressure recovery above it depend on the internal energy of the fluid. As the condensate above nearly approaches steam temperature, its internal energy is enough to overcome the upward force at the inlet tube and the disc snaps down in the inlet tube, which is the inlet valve seat.

Simultaneously, the disc also seals the outer ring, which isolates the space above the disc from the outlet. The disc valve is therefore held firmly against the inlet valve seat until the pressure in the control chamber is reduced by condensation. The upward force then exceeds the downward force and the disc valve opens.



This 3-part Sarco TD Steam Trap has only one moving part—the hardened, polished stainless steel disc.

No other trap uses the velocity of the fluid to operate the valve or uses the recompression of the flowing fluid to trap the valve closed and to hold it closed. When it closes, it closes tightly – no "operating steam" leaks out.



40 seconds inspection time— that's all it takes for a SARCO TD Steam Trap

Just back off the cap of a Sarco TD. Lift out its single moving part, the stainless steel disc. Wipe it off, and drop it back. No adjustment is ever required, at any load or any pressure in its range – from 10 through 600 psi.

The TD operates in any position, won't blow steam at any load. Small as a tee fitting, it can be installed in tight places. Its versatility and reliability cut cost of big replacement inventory.

Write for "Literature Kit 2A" today and get latest bulletins on the TD Steam Trap and other Sarco steam traps. Remember that Sarco can give you impartial advice on *Production Planned steam trapping* because . . .

5605-B

SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

Only Sarco makes all 5 types:
Thermostatic • Liquid Expansion • Float Thermostatic
Thermo-Dynamic • Bucket

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

where trouble-free performance is a matter of pride...

DOW CHEMICAL COMPANY, TEXAS DIVISION, FREEPORT, TEXAS

SCOVILL

Heat exchanger tube

One of the largest of The Dow Chemical Company's manufacturing installations is the Texas Division, where, in complex and brilliantly-painted plants hundreds of different components are processed and re-shaped to produce more than 40 fundamental chemical products.

Chemical process condensers such as this at The Dow Plant, Freeport, Texas, are vital links in the production chain and are tubed with Cupro-Nickel, 30% Heat Exchanger Tubes.

Combining excellent corrosion-resistant properties with very favorable mechanical properties, Scovill Tubes of this alloy make an important contribution to the trouble-free operation of these key units under very exacting service conditions.

Let Scovill Technical Service . . . most experienced in the field . . . help you establish the best heat exchanger tube specifications for equally trouble-free service in your own heat transfer equipment.

MADE IN U.S.A.
TO THE STANDARDS
OF AMERICAN INDUSTRY

HEAT EXCHANGER TUBE for Applications from Marine to Petrochemical, from Compressor Intercoolers to "Cat-Cracker" Exchangers, in these popular Alloys . . . Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Red Brass, 85% • Deoxidized Copper • Arsenical Copper • Cupro-Nickel, 10%-20%-30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

SCOVILL MANUFACTURING COMPANY, Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

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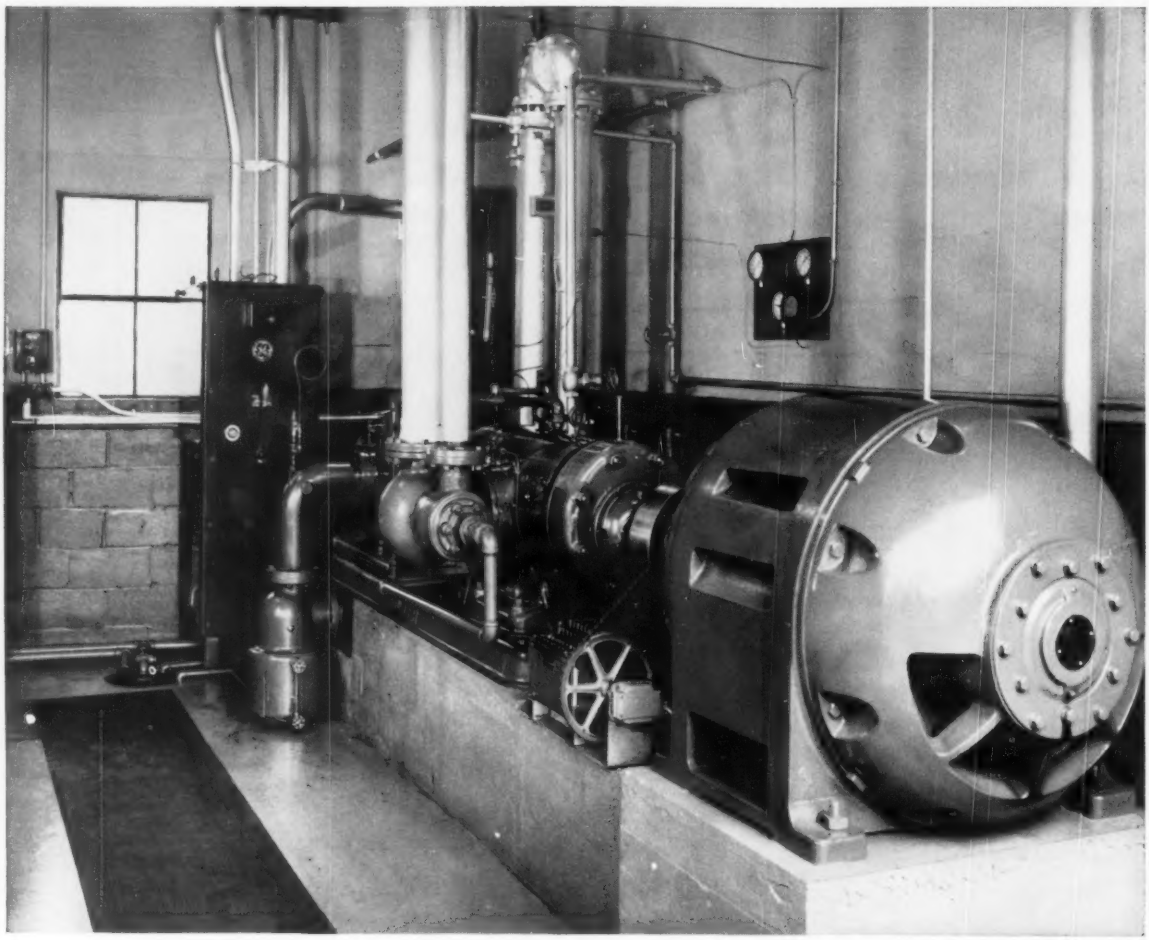

Fuller Rotary Two-Stage Compressor, C135-135H. Capacity 680 c.f.m., 100-lb. pressure, 690 r.p.m., 150 hp. motor.

16,000 HOURS OF OPERATION WITH NO MAINTENANCE

Empire Steel Castings, Inc., Reading, Pennsylvania, installed a C-135-135H Fuller Rotary Two-stage Compressor in April 1953. After 32 months—approximately 16,000 hours of operation—the compressor received a routine inspection, when a new set of blades was installed in the higher-pressure cylinder.

The Empire engineers report no downtime since replacement, although they've added 4,000 operating hours. Prior to switching to Fuller, their former experience with compressors was a different story—as many as several overhaulings in one year. With Fuller equipment furnishing a constant high capacity air supply, production costs have been greatly reduced.

Here's how Empire uses compressed air:

- In the molding department, supplying all air for pneumatic rammers, all squeeze and jolt machines, automatic set-out and lifting apparatus of mold conveyors, automatic shake-out machines, mold cleaning and spraying equipment.
- In the core department, for ramming equipment, spraying and torch drying equipment, core oven operation as well as core blowing equipment.
- In the cleaning department, pneumatic chipping hammers and grinders, blacksmith requirements, sand-blasting, pressure testing and miscellaneous tools.
- In the heat-treating department, heat treating furnace operation and cooling equipment.

To get all the facts and engineering data, write today for Bulletin C-5A.

C-298
3662

FULLER COMPANY
GENERAL AMERICAN
TRADE MARK

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
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Fuller

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

For Fly Ash Collection...

Western Precipitation
presents
its latest development
in a quarter-century of
continuous advancement
in Mechanical Collectors

...The "9VGR" MULTICLONE!

Over 25 years ago

Western Precipitation Corporation pioneered the high-efficiency multiple-tube principle that has proven so superior it is now the pattern for the industry.

The Multiclone continues to be years ahead of all other centrifugal collectors because it incorporates the invaluable "know-how" gained through these many years of leadership in the field —leadership that is further emphasized by introduction of the 9VGR Multiclone, another important milestone in Multiclone's quarter-century of outstanding performance.

NEW 9VGR FEATURES...

1. *No need for continuous external support.*
2. *Easier and less costly to insulate.*
3. *Minimum dust stratification.*
4. *Improved dust distribution to all tubes.*
5. *Simpler installation, lower erection costs.*
6. *Freedom from leakage at all critical points so that full collection efficiency is obtained.*

Plus **The proven superiority of CAST IRON TUBES and VANES!**

Through the years, others have tried special alloy steels and so-called "miracle" metals, but nothing has proven as satisfactory *in actual field service* as cast iron. In the past quarter-century more than 270,000 Multiclone tubes have been placed in service with less than 1.85% replacement—*a performance record unequalled in the industry!*

There are many other advantages built into the 9VGR. There is a Multiclone representative near you who will be glad to supply complete details. Or write direct, asking for your free copy of Bulletin #M209 which contains full details.

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
HOLO-FLITE Processors
HI-TURBIANT Heaters

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PRECIPITATION
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Engineers and Constructors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

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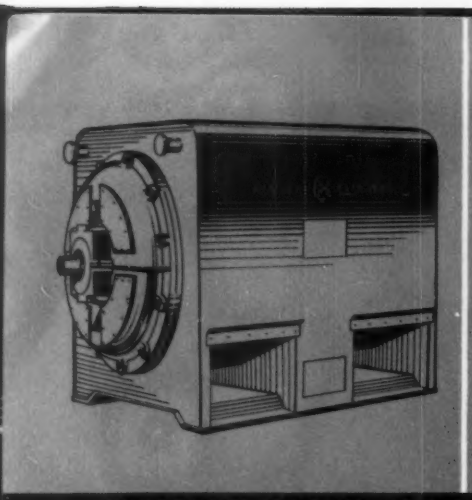
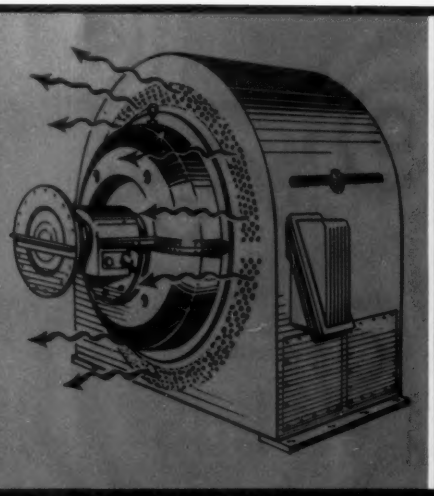
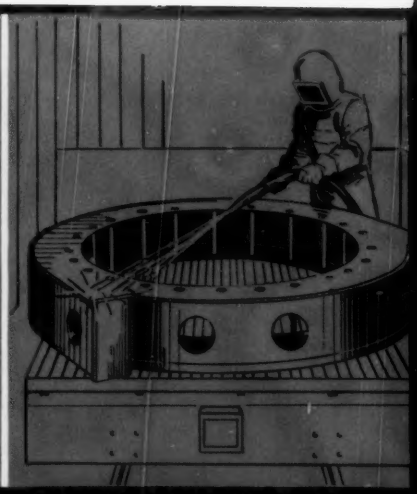
Precipitation Company of Canada Ltd., Dominion Square Bldg., Montreal



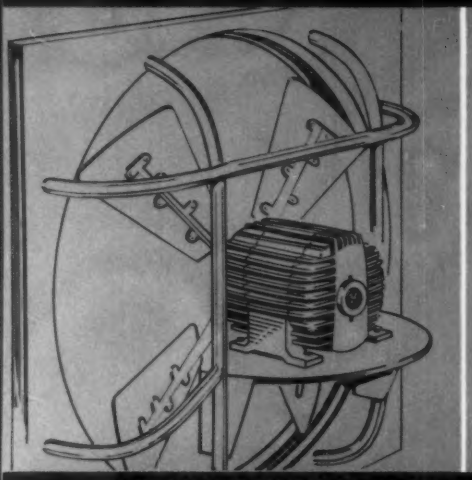
NEW WEATHER PROTECTED MOTORS—over 3 hp per rpm and above—are custom designed to give NEMA type II protection where totally enclosed motors cannot be economically justified. GEZ-2771.



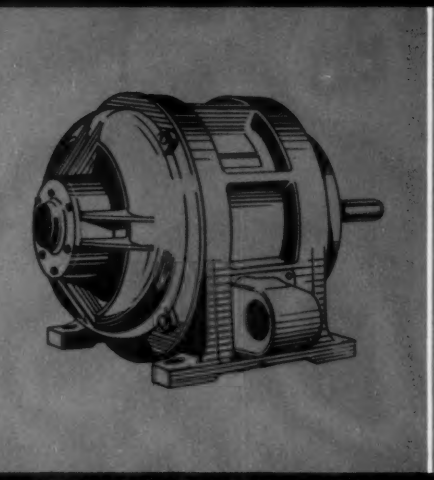
TUBE-COOLED VENTILATION provides more effective cooling for very large, totally enclosed motors. A fan forces air through specially-designed tubes in motor frame, achieving maximum heat dissipation.



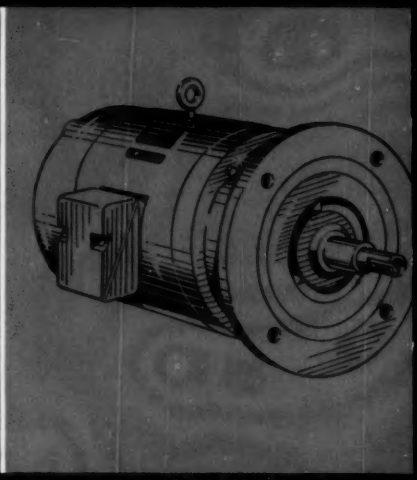
"SHOT BLASTING" OF WELDMENTS on large G-E motors prepares surfaces for longer-lasting finish. Tiny steel pellets are blasted at frames to clean away welding flux, dirt, etc., before painting.



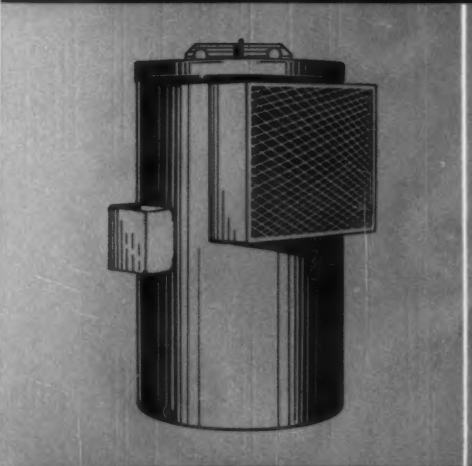
NEW TOTALLY ENCLOSED AIR-OVER MOTOR—7½ to 100 hp—achieves more efficient air flow at lower cost. Permits higher full-load speeds, greater fan output. Up to 20% smaller, 30% lighter. GEA-6598.



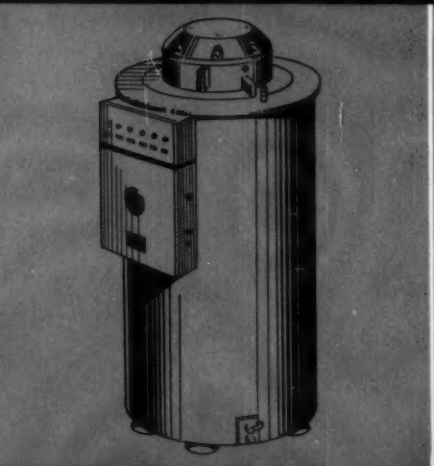
NEW COTTON GIN MOTOR—30 to 100 hp—has oversize shaft and bearings (up to two sizes larger) for greater reliability and longer life. Smooth open design achieves maximum lint expulsion. GEA-6765.



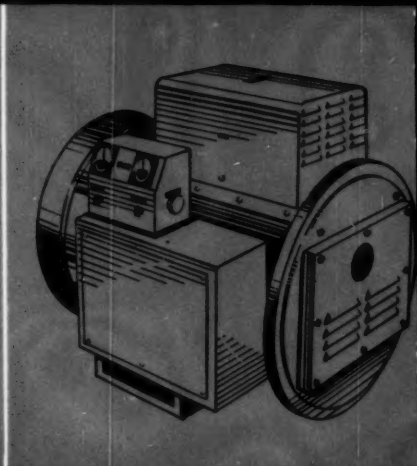
NEW SLUSHER HOIST MOTOR—up to 125 hp—provides greater burnout protection through increased stall capacity and greater stability under extreme loads. Designed to withstand extreme mine abuse.



NEW 20- TO 100-KW VERTICAL MOTOR-GENERATOR features air-cooled design, lower excitation, reduced size, and sound-baffled construction. Self-leveling feet simplify installation. GEA-6826.



NEW VERTICAL HIGH-FREQUENCY M-G SET—150 to 500 kw—for heating and melting, features top-mounted thrust bearings to speed maintenance, extra built-in contactors for remote shut-off. GEA-6809.



NEW PACKAGED SYNCHRONOUS GENERATOR—175 to 300 kw—has static exciter-regulator for low maintenance. Easy to install. GEA-6808. 40-to 150-kw ratings feature brushless construction. GEA-6844.

BUSINESS UPTURN GIVES NEW REASONS TO . . .

Buy General Electric Motors NOW For Extra Values

With the business upturn under way, now is the time to modernize with General Electric motors — to get faster delivery, better prices, and new product features.

In connection with "Operation Upturn" — G.E.'s business acceleration and modernization program — General Electric motors now provide over 150 specific *extra values* to help utilities, equipment manufacturers and motor and generator users throughout industry reduce costs and increase production.

Never before have values been so great. Never will there be a more favorable time for you to buy these modern General Electric motors than *right now.*

For more information on G-E extra *motor and generator* values, contact your nearby G-E Apparatus Sales Office or distributor, or write for listed bulletins. General Electric Company, Schenectady, New York.

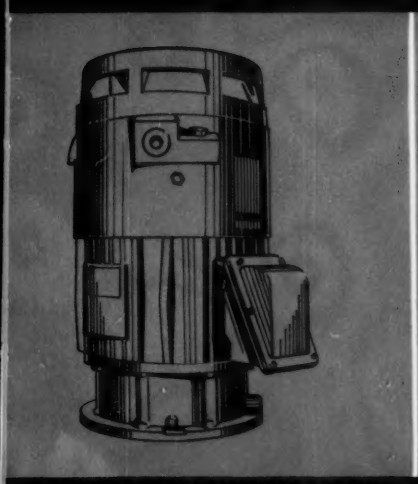
502-2

OPERATION upturn — Buy more for extra values — GENERAL ELECTRIC

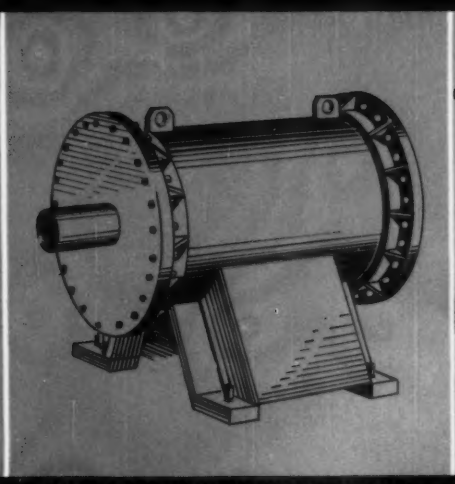
GENERAL ELECTRIC

FASTER RENEWAL PARTS SHIPMENT —for 150- to 5000-hp motors—helps cut downtime losses. Form coils have been delivered, coast to coast, in as little as 5 days. Air freight can be used if necessary.

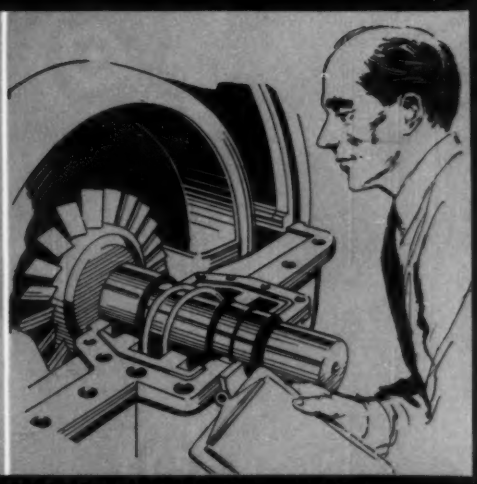
CONSOLIDATED STATOR WINDINGS —stators are flood-dipped with Glyptal® varnish to consolidate all ties and wedges as an integral part of the stator and to seal out dust, contaminants.



NEW VERTICAL TEFC MOTOR—7½ to 100 hp—provides long, dependable operation in severe weather. Available with either solid or hollow shaft. Ideal for toughest power station or industrial use.



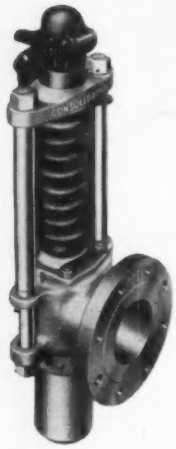
NEW LARGE-SIZE HERMETIC MOTOR —100 to 1000 hp—offers quieter operation and minimum vibration for centrifugal air-conditioning systems. Motor is specially insulated for use in Freon.



BEARING & LUBRICATION RESEARCH —in new AC Motor Development Center —provides extra values for tomorrow's motors as well as today's. Projects include a new grease with 50% longer life.

STOPS VALVE LEAKAGE

at high pressures



Consolidated "Maxiflow" Safety Valve, Type 1700 Series, Sizes: 1½" thru 6".

The Thermodisc Seat in Consolidated "Maxiflow" Safety Valves solves the problem of valve leakage at high pressures, saves steam and reduces maintenance.

Research has shown that when a safety valve on high pressure service reseats after popping, a small amount of leakage occurs momentarily between seat and disc before the valve seals off and becomes tight. This leakage is comparable to steam flow through small, individual orifices.

When a small steam leak exists at some point on the valve seat, the area near the point is cooled by the refrigeration effect of the escaping vapor. The metal tends to contract causing slight deformation of the seat. This acts to increase the gap size between disc and seat bushing at the leakage point. The size of the gap increases rapidly until the rate of leakage becomes extremely high.

The Thermodisc Seat prevents seat distortion and consequent leakage with a seat element recessed to form a thin wall at the area of seat contact. This design permits a high rate of heat-transfer in the metal *that eliminates all thermal differences.*

The result is a degree of tightness, essential to the operation of safety valves in high pressure services, never previously achieved. For complete details, write for Bulletin 707B.

MANNING MAXWELL & MOORE INC. MM&M TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

Maybe *you'll soon have this decision to make*

LUBRICATION CASE STORY ON THE NEW WORTHINGTON AT INDEPENDENCE, IOWA

Situation: Gene Williamson, plant superintendent, had a decision to make when the Independence, Iowa, Municipal Light Plant installed a new 3600 Horsepower Dual-Fuel Worthington last year. What lubricating oil to use? Other equipment in the plant was lubricated with STANODIESEL Oil M. Performance was excellent. Lubrication technical service performed by men with experience and training for the job likewise was excellent.

What was done: The decision was made to install STANODIESEL Oil M. Now after 3,780 hours of operation, there are no regrets. There are no signs of wear.

STANODIESEL Oil M is refined from the finest-quality base stock. Additives help the oil resist viscosity change, keep engine parts clean. Other additives control foam, make it possible for oil to reach and hold protective film on even the most difficult to lubricate parts.

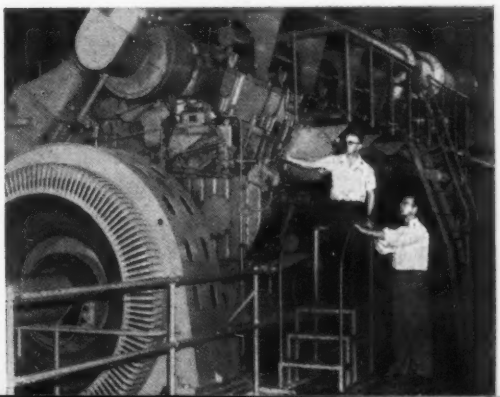
What you can do: Get all the facts about STANODIESEL Oil M from your Standard Oil lubrication specialist. There's one near you in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Illinois.**

Quick facts about

STANODIESEL OIL M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult to lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.

You expect more from **STANDARD** *and get it!*



Running smoothly. Gene Williamson, power plant superintendent, and Standard Oil's Bob Wenger (right) check over new Worthington Dual-Fuel engine. Good lubrication technical service is one of the reasons Williamson decided upon STANODIESEL Oil M when engine was installed. Bob Wenger is well qualified by both experience and training to provide such technical service. He has been doing this work for nine years. In addition, he has an engineering degree from Iowa State and has completed the Standard Oil Sales Engineering School.

IDEAS AND PEOPLE MEET AT THE POWER SHOW, ED. I CRAM DOZENS OF CRUCIAL CONTACTS INTO MY VISIT TO THE SHOW. I SOLVE PROBLEMS, AND GET MANY NEW IDEAS FOR CUTTING COSTS IN THE PLANT.
YES, BILL. THAT'S WHY I BRING MY KEY MEN ALONG. THEY GET A NEW PERSPECTIVE ON THE INDUSTRY, AND THE FUTURE. THEY GO BACK TO THEIR JOBS RECHARGED WITH IDEAS. THEY'RE WORTH MORE TO OUR COMPANY, AND I AM TOO.
ELECTRUNITE TUBING

You, too, will find new ways of cutting costs at the

23rd National Exposition of Power & Mechanical Engineering

Auspices of ASME

New York Coliseum December 1–5, 1958

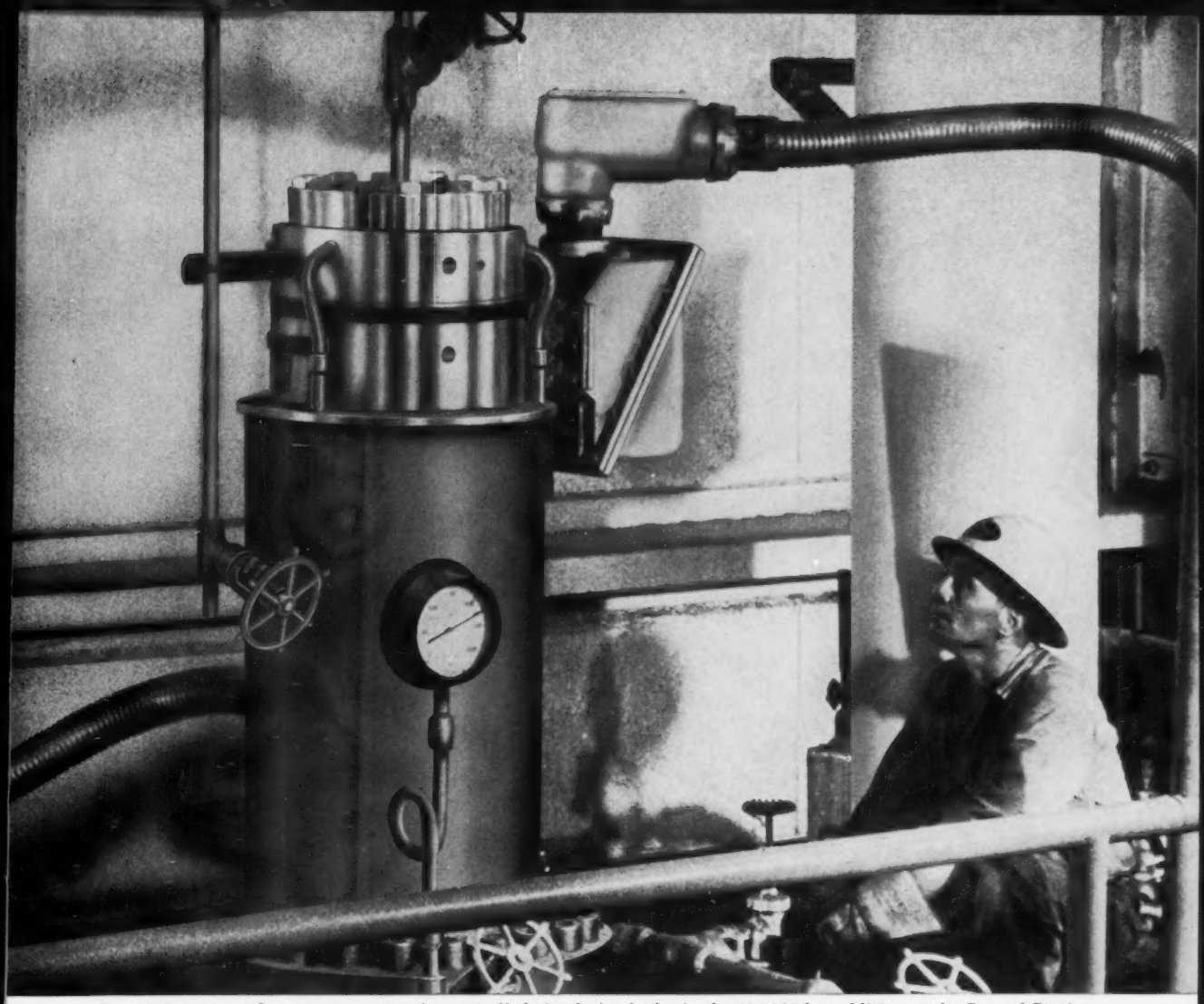
Visit, See and Hear

- 300 fact-filled displays (for you to see)
- 2500 technical representatives to help solve your problems
- 110 informative technical sessions of ASME
- All to bring you up to date on the newest developments, methods and products.

A visit to the Power Show will increase your value to your company, improve your "Job-Ability."

The Power Show is held in conjunction with the annual meeting of the American Society of Mechanical Engineers. Don't miss it! Register by mail today and save time later. No charge. Write to the Exposition at 480 Lexington Avenue, New York 17, N. Y.

Management: International Exposition Company



One of three canned motor-pumps on the controlled circulation boiler in the 125,000-kw addition to the Seward Station.

PENELEC'S

First annual inspection of Westinghouse Canned Motor-Pumps

Pennsylvania Electric Company reports: after the first annual inspection, the Westinghouse canned motor-pumps on the controlled circulation boiler at the Seward Station were in excellent condition.

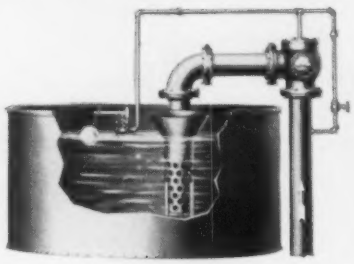
One pump was operated continuously throughout the 276 days that the boiler was in service. The other two units alternated between full operation and hot standby. This operating experience demonstrates the trouble-free and reliable service that can be expected from Westinghouse canned motor-pumps.

For information on the advantages of these leak-proof pumps for controlled circulation boilers and other uses, contact your Westinghouse sales engineer, or write: Westinghouse Electric Corporation, Atomic Equipment Department, Cheswick, Pa.

J-57017-R-2

YOU CAN BE SURE...IF IT'S Westinghouse

If you have a
liquid level control problem

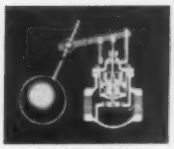


call for a valve from

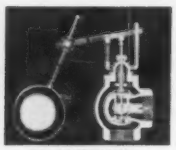
Klipfel

No matter what type of float valve you want, Klipfel has it. And you can get it quickly. Direct Action and Pilot Control, Single and Double Seated Float Valves are all available to give automatic level control of any liquid in large as well as small installations. Valves of special design, and/or corrosion-resistant materials built promptly.

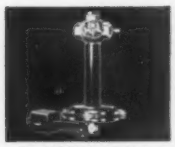
Call your supply house, or write for Bulletin 254.



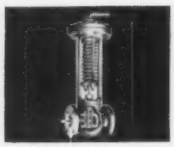
No. 7 Float Valve



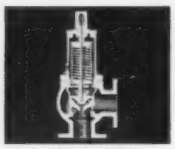
No. 27 Float Valve



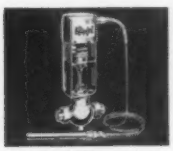
No. 410 Reducing Valve



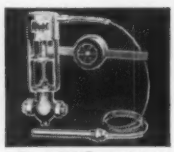
No. 300 Reducing Valve



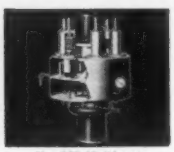
No. 135 Relief Valve



No. K-449 Temperature Regulator Valve



No. K-348 Temperature Regulator Valve



No. 135 Multiport Relief Valve

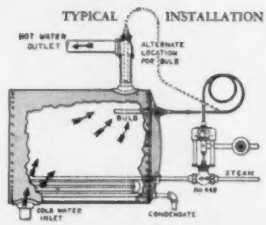
HAMILTON • OHIO **Klipfel** VALVES INC.

Automatic Temperature-and-Pressure-Regulating Valves Since 1902

Float Valves • Temperature Regulators • Back Pressure Valves • Reducing Valves

A DIVISION OF THE HAMILTON-THOMAS CORPORATION

If you need to control
tank temperature



call for a valve from

Klipfel

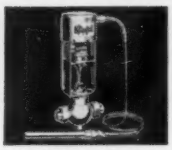
Klipfel Temperature Regulator Valves operate without auxiliary power. Pressure changes in a temperature-sensitive bulb are transmitted to a seamless, 2-ply, extra-strong bellows which opens or closes the valve smoothly to maintain desired temperature.

Wide Temperature Range **Indestructible Yoke**

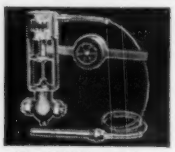
Direct or reverse action **Manual override**

Single, double or three-way bodies

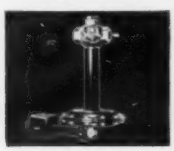
Call your supply house or write for Bulletin 354-A.



No. K-449 Temperature Regulator Valve



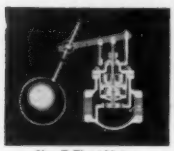
No. K-348 Temperature Regulator Valve



No. 410 Reducing Valve

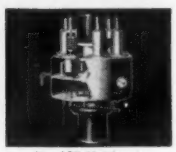
No. 300 Reducing Valve

No. 135 Relief Valve



No. 7 Float Valve

No. 27 Float Valve



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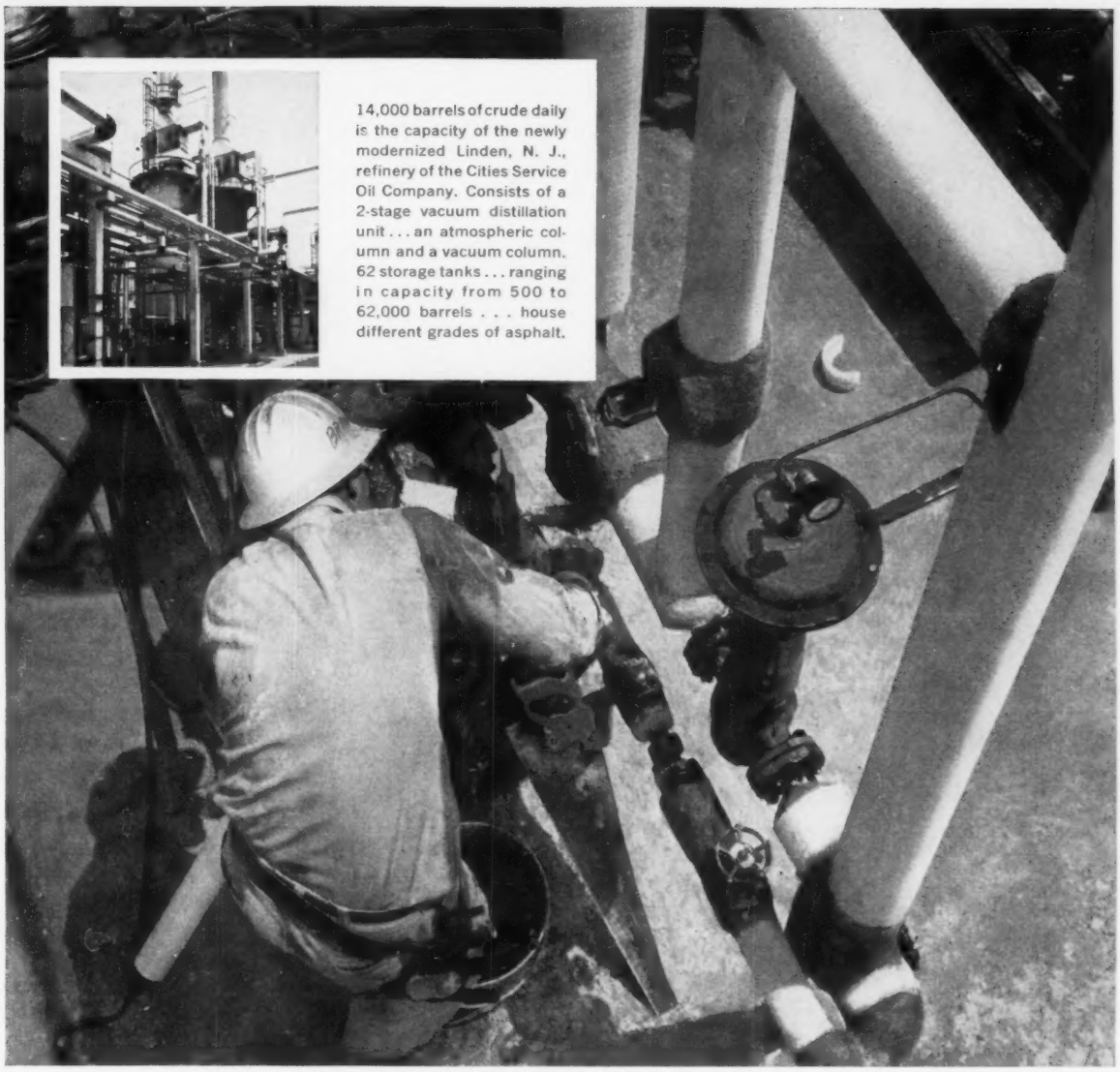
Float Valves • Temperature Regulators • Back Pressure Valves • Reducing Valves

A DIVISION OF THE HAMILTON-THOMAS CORPORATION



14,000 barrels of crude daily is the capacity of the newly modernized Linden, N. J., refinery of the Cities Service Oil Company. Consists of a 2-stage vacuum distillation unit . . . an atmospheric column and a vacuum column. 62 storage tanks . . . ranging in capacity from 500 to 62,000 barrels . . . house different grades of asphalt.

138,000 feet of "K&M" KaytherM Block Insulation and 56,000 feet of "K&M" KaytherM Pipe Insulation handle a range of operating temperatures from 90°F. to 700°F.

"K&M" KAYTHERM KEEPS A RIVER OF ASPHALT FLOWING AT NEW CITIES SERVICE REFINERY

You've got to keep asphalt hot in order to keep it moving. And, move it must . . . from distillation unit to storage tank . . . It's outdoor travel . . . where the insulation must be strong and tough enough to withstand the ravages of weather.

That's why you'll find "K&M" KaytherM Pipe and Block Insulation on the job at this modern, new refinery. It's weather-resistant and chemically stable . . . doesn't disintegrate or lose efficiency. Remains highly efficient to 1350°F.

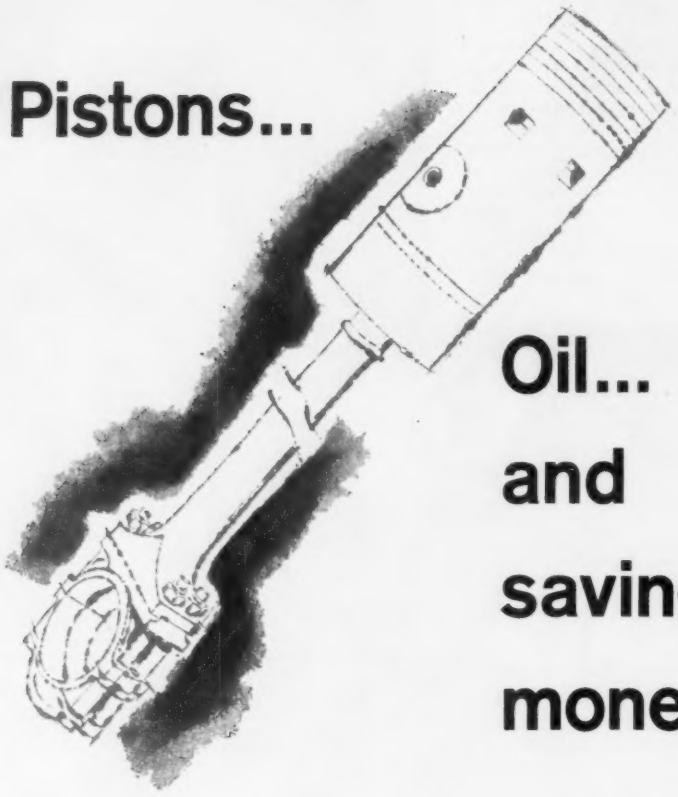
Strong, lightweight, and easy to work, "K&M" KaytherM reduces installation and maintenance costs. You can use it indoors or outdoors for every use.

Write today for more information on this hydrous calcium silicate insulation.

K·M
BEST IN ASBESTOS

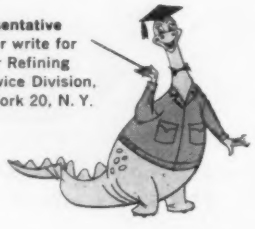
KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

Pistons... Oil... and saving money

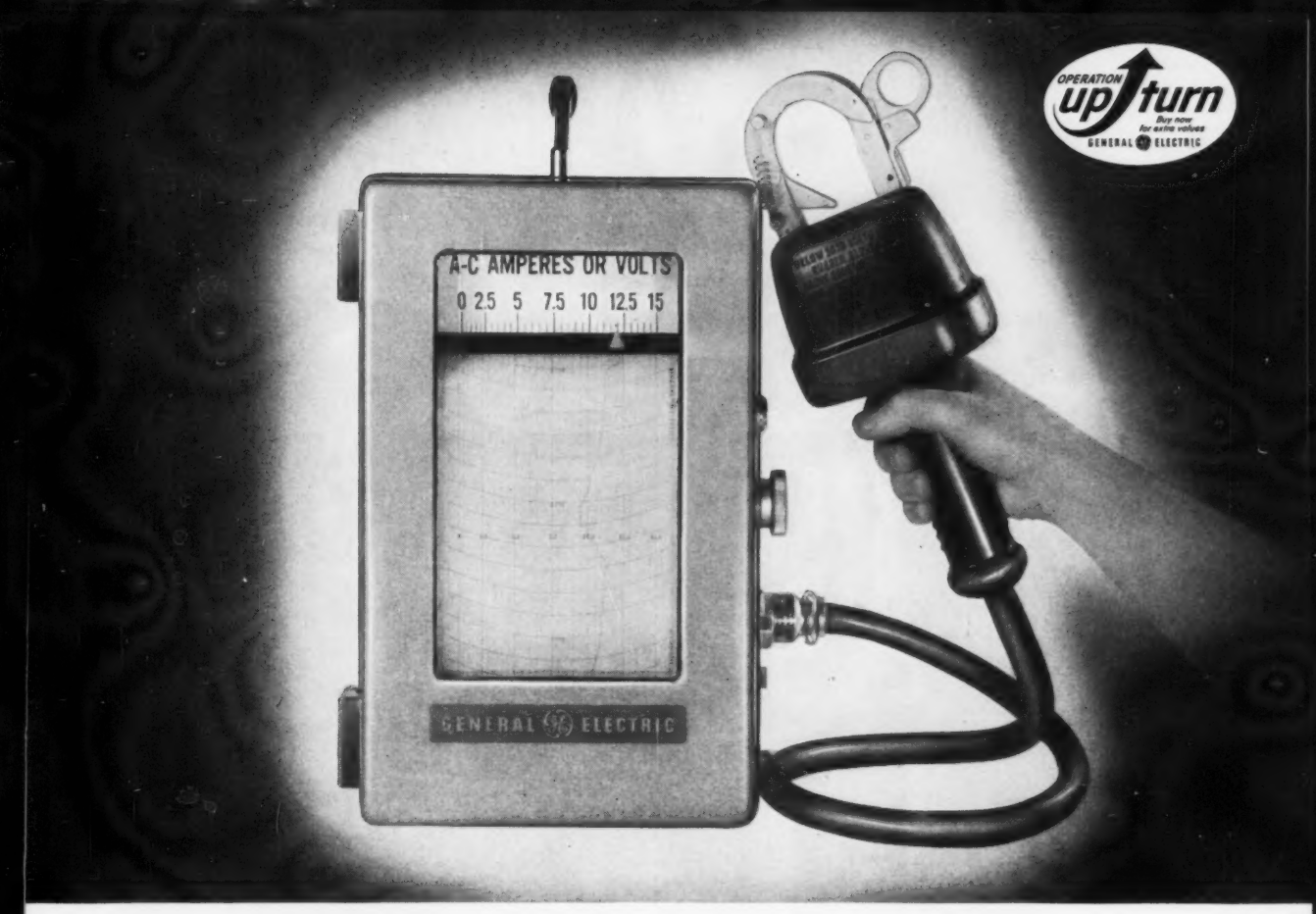


The longer your pistons work before need of ring replacement—the less your cost of operation. Sinclair Rubilene® Oils have the reputation for giving longer service to cylinders, rings and other vital parts. Refill with Rubilene now. Next time management asks how you've cut costs, tell them you've switched to Sinclair—and show them the results.

Call your Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There's no obligation.



SINCLAIR
Rubilene® Oils



NEW CH-7 Volt-Ammeter features hook-on convenience with continuous-line recording and spring-clock chart drive

Now you can get the convenience of a hook-on volt-ammeter combined with a continuous-writing strip-chart recorder and a 60-day spring-clock chart drive.

CONTINUOUS-WRITING MECHANISM

The new General Electric CH-7 recorder can measure rapidly-changing currents and voltages, recording all dips and peaks. The writing pen is driven by an element with a fast (0.7 second) response time.

No power source is needed when the CH-7 is supplied with the hand-wound, spring-clock chart drive. Just hook on, and you can record up to two months' operation with no servicing.

INDUSTRIAL AND UTILITY APPLICATIONS

Industrials can use the CH-7 to record fast changing motor loads, to measure machine load cycles, and for electrical maintenance in the shop.

Utilities and Rural Electric Cooperatives can make load surveys, even where electrical power is unavailable for the chart drive, by using the 60-day, hand-wound, spring clock.

FEATURES HOOK-ON TRANSFORMER

The CH-7 is essentially a modification of the portable CH recorder, retaining all of the advantages such as the "throw-away" inkwell, the 150-foot record roll, and the versatile chart drives.

It is designed for use with the identical Butyl-molded transformer that has proved so successful with the CF-7 recorder. With this adaptation, the CH-7 offers current measurements with no interruption of service, hook-on installation, 8700-volt insulation, and automatic, short-circuit protection.

CHOICE OF CHART DRIVES

CH-7 recorders are now available with three different chart drives:

1. Single-speed, synchronous motor, 120/240 volts, 60 cycle.
2. Double-speed, synchronous motor, 120/240 volts, 60 cycle.
3. Spring-clock chart drive.

You also get more for your instrument investment because of the recorder's many ranges:

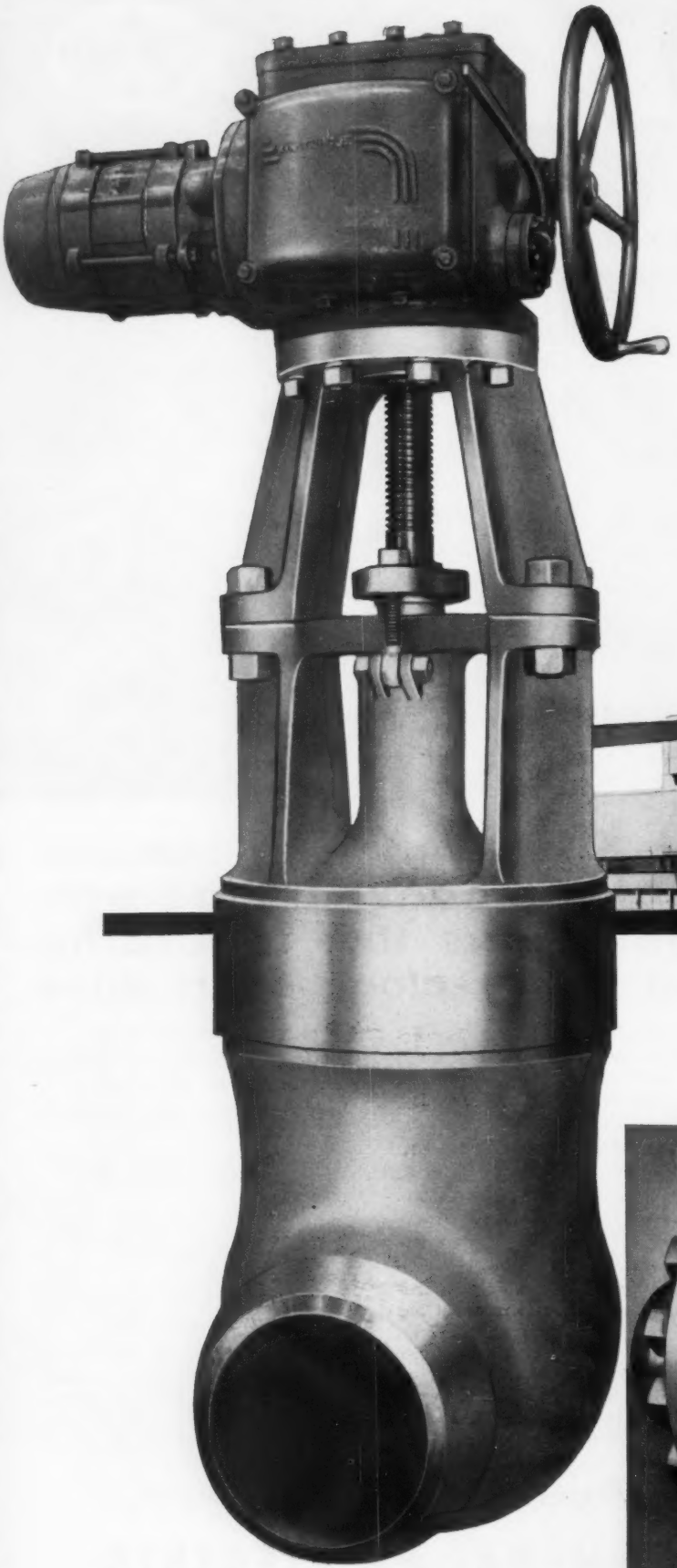
15/30/75/150/300/750 amperes A-C and 150/300/750 volts A-C.

For complete facts on all General Electric recorders, contact your nearest G-E Apparatus Sales Office or Distributor, or write to Section 582-30, General Electric Co., Schenectady, N. Y.

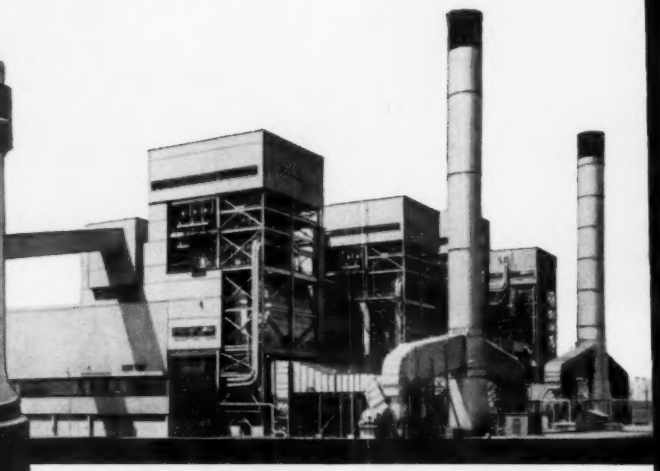
Progress Is Our Most Important Product

GENERAL ELECTRIC

Under pressures from 2500# to 150# psi . . .

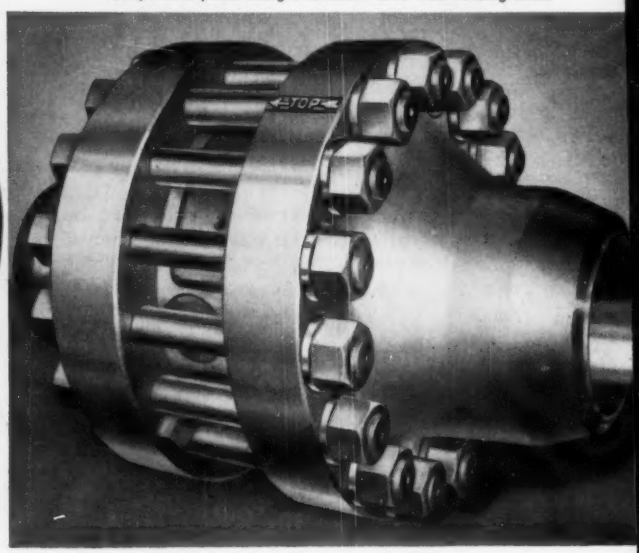


Typical of the Chapman 2500# psi alloy steel valves used in Kansas City. Has welded body and bonnet connection and is equipped for motor operation.



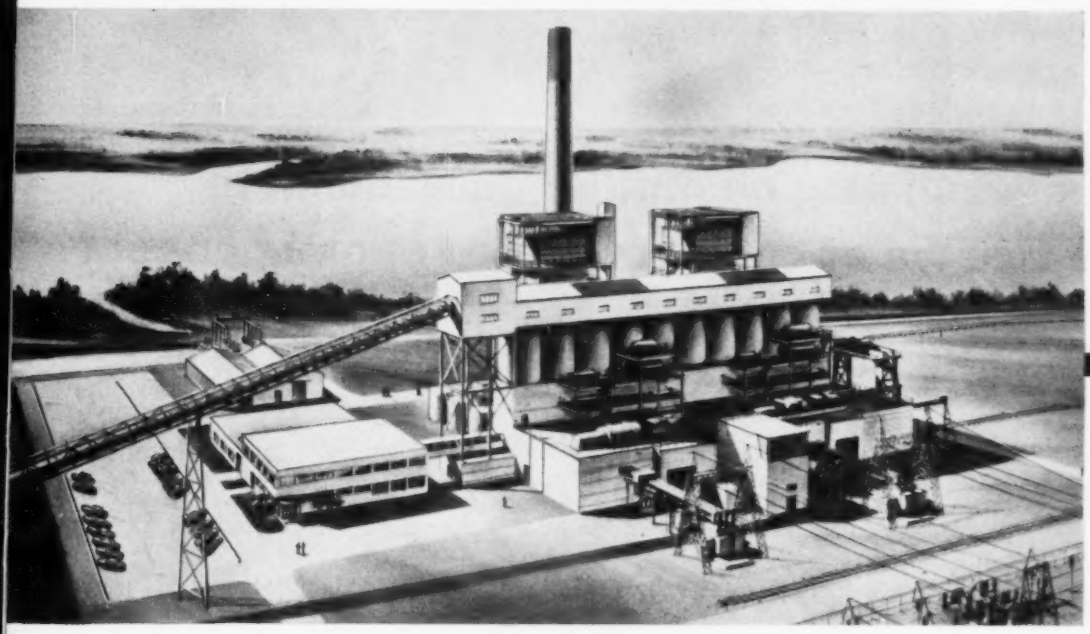
The Hawthorn Station of Kansas City Power & Light Co. located in Kansas City, Mo.

Chapman 3-piece tilting disc check valve with welding ends.



CHAPMAN VALVES

are doing a job for Kansas City Power & Light Co.



(Left) New Montrose Station, located 60 miles Southeast of Kansas City.

Ebasco Services Incorporated, acted as Engineers and Construction Managers for Kansas City Power & Light Co.

Here's a good example of what Chapman Valves can do for power plants.

In the Kansas City power plants, pressure requirements are varied . . . from 2500# to 150# psi. And Chapman Valves are meeting the specified pressure-temperature ratings . . . Chapman alloy steel gate, globe, swing check and tilting disc check valves . . . Chapman Valves, both hand and motor operated . . . Chapman Valves with welded body and bonnet or pressure seal.

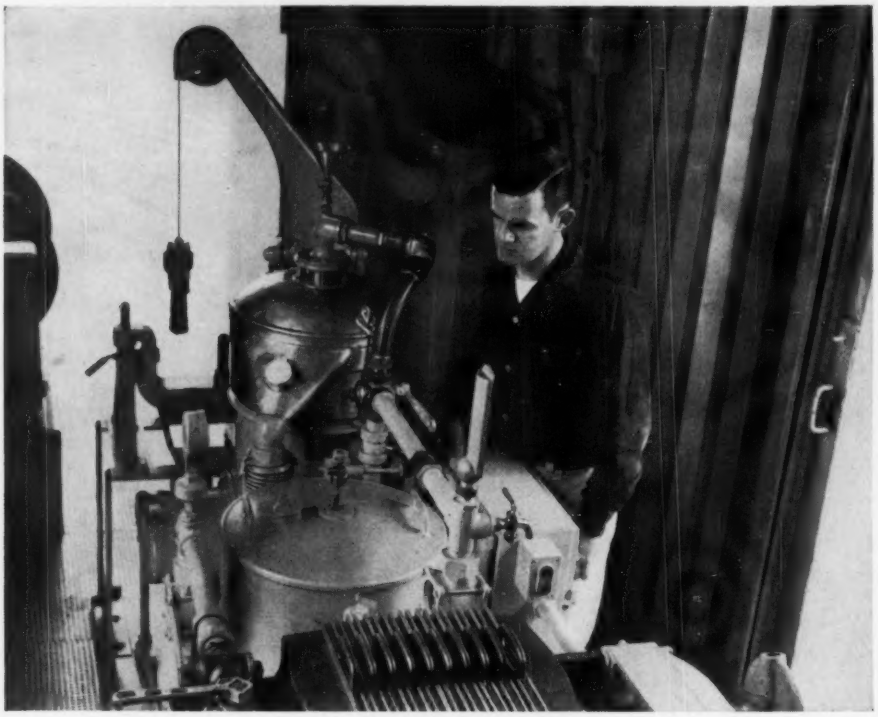
In Kansas City, you'll find Chapman Valves in the 332,000 KW Hawthorn Station. You'll find them in the first brand new 156,250 KW unit at Montrose Station. You'll find them in the second Montrose unit scheduled for completion in 1960.

The reason for all this makes an interesting story. Chapman goes all out . . . 100 per cent . . . to meet valve requirements in a true engineering way. Upon request, one of our engineers will gladly talk to you about it.

The **CHAPMAN** *Valve Manufacturing Co.*

INDIAN ORCHARD, MASSACHUSETTS

For over 75 years, Chapman has been designing, developing, improving, building, testing and delivering valves to meet usual and special requirements for power plants, water works, chemical plants, refineries and industrial use.



Truck-mounted for convenient field use, this De Laval Insulating Oil Purifier provides safe, positive protection for oil-insulated transformers, circuit breakers, and oil-immersed switches for the MEMPHIS LIGHT, GAS and WATER DIVISION, Memphis, Tennessee.

De Laval insulating oil purifier guaranteed to reduce free water content to 1/1000 of one per cent

Every De Laval Insulating Oil Purifier is guaranteed to reduce free water content of new transformer oil from an initial 1/10 of one per cent to 1/1000 of one per cent. Further, the machines are guaranteed to raise the dielectric strength of the oil to 30-KV... all at 90°F. and *in a single pass.*

With a De Laval Insulating Oil Purifier, you achieve highly efficient oil purification at temperatures of 90 to 110°F. These low temperatures virtually eliminate the possibility of water going into solution and precipitating later as free water finely dispersed in the oil... a major drawback of high-temperature oil purification in this application.

Centrifugal force thoroughly separates water and sediment from the oil. Water is discharged continuously; sediment is collected in the bowl. Reclaimed oil is both pure and high in dielectric strength.

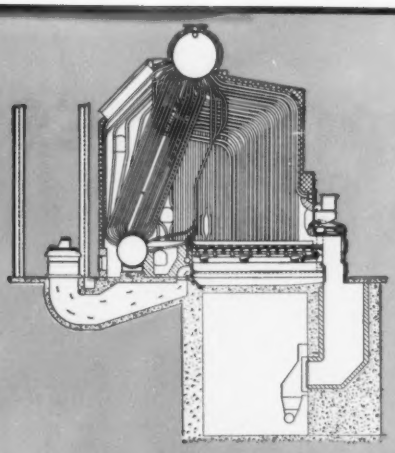
As optional equipment, you can get a filter press on the De Laval Purifier. Used only for the removal of colloidal carbon and finely dispersed particles, it is a simple addition to the purification unit. Furthermore, the De Laval engineering staff, working with your own engineers if you like, will design a complete purification system including the heating element, controls and accessories.

Whatever the size of your plant or sub-station, there is a De Laval Insulating Oil Purifier suited to your needs and budget. For information on capacities and specifications, or if you'd like a personal consultation with a De Laval Sales Engineer, just drop us a line on your letterhead.

DE LAVAL
SEPARATOR COMPANY

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York
or 427 Randolph Street, Chicago 6, Illinois

DE LAVAL PACIFIC COMPANY,
201 E. Millbrae Avenue, Millbrae, Calif.



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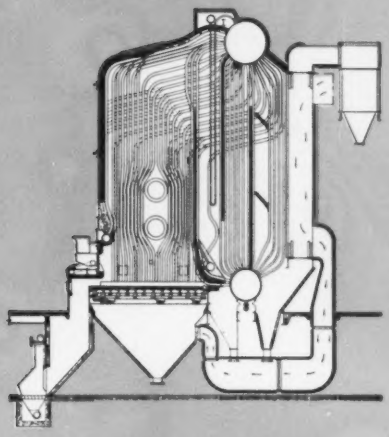

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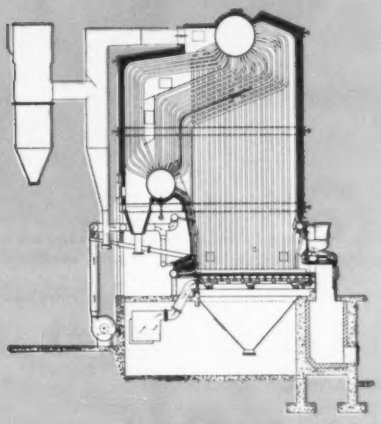

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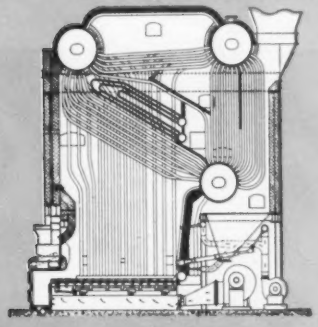
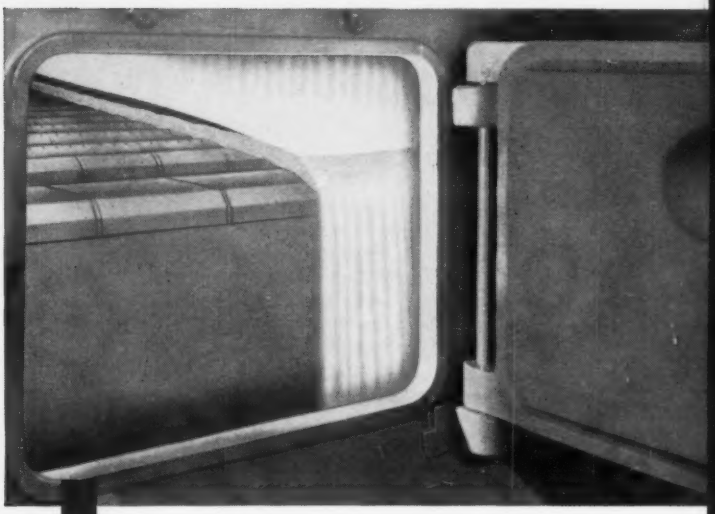


4.

EASILY APPLIED TO
new or existing boilers
Detroit RotoStoker type C-C
(continuous cleaning)



Popular because the reciprocating grate continuously discharges the ash, for easy removal through doors in the front at floor level or by conveyor.

May be applied to new or existing boilers of all types with low construction expense.

Smokeless operation assured through wide load range.

Detroit RotoStoker Type C-C efficiently burns Bituminous Coals and Lignite without special preparation.

Get full information on the Detroit RotoStoker Type C-C . . . Write for Bulletin 800. No obligation.

1. **Detroit RotoStoker Type C-C with Babcock & Wilcox Boiler—35,000 lbs. per hr.**
2. **Detroit RotoStoker Type C-C with Union Boiler—46,000 lbs. per hr.**
3. **Detroit RotoStoker Type C-C with Springfield Boiler—50,000 lbs. per hr.**
4. **Detroit RotoStoker Type C-C with Wickes Boiler—40,000 lbs. per hr.**

DETROIT ROTOSTOKER TYPE C-C

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN District Offices or Representatives in Principal Cities

H-W PLASTIC REFRACTORIES

make durable, efficient and economical

BOILER FURNACE SETTINGS

Harbison-Walker Plastic Refractories comprise all the kinds best adapted for the many different operating conditions. They form solid, joint-free linings including arches and bridge walls having physical properties closely similar to the corresponding classes of refractory brick.

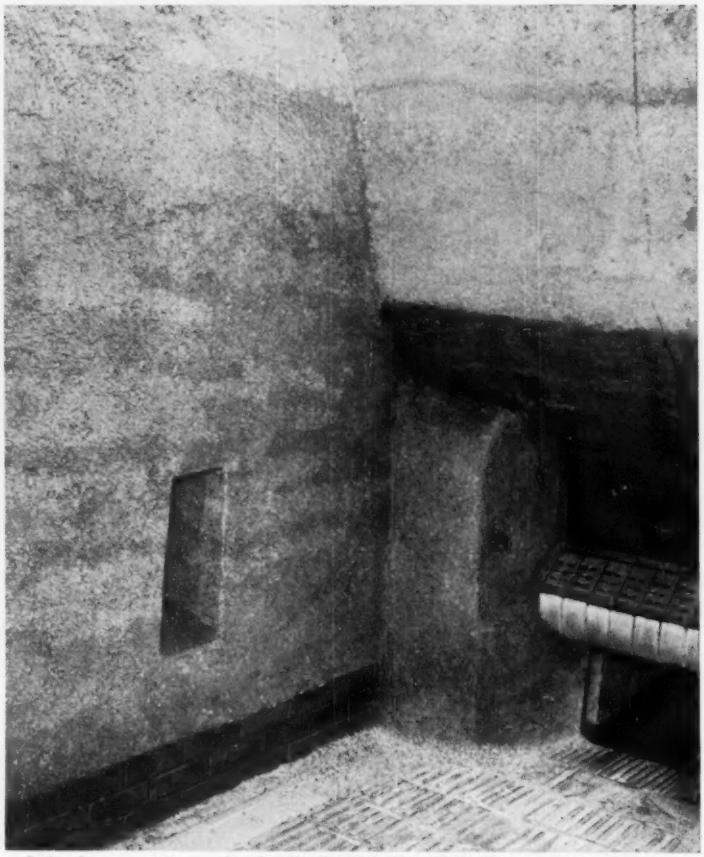
H-W STANDARD PLASTIC FIRE BRICK is a dense-burning, uniform refractory made of the same clean, high purity flint clay of hard burn and plastic bond clay as are used in the best high duty fireclay brick.

H-W SUPER PLASTIC FIRE BRICK possesses the properties of super-duty fireclay refractories and is used economically in applications where temperatures exceed the limits for **H-W STANDARD PLASTIC FIRE BRICK.**

H-W SUPER PLASTIC CS takes a cold-set after drying in the low temperature range. This added strength prior to the development of the usual strong ceramic set is especially desirable for certain furnace installations.

APACHE PLASTIC FIRE BRICK is the high-alumina plastic refractory which withstands the highest temperatures to best advantage and is most resistant to chemical attack by corrosive slags.

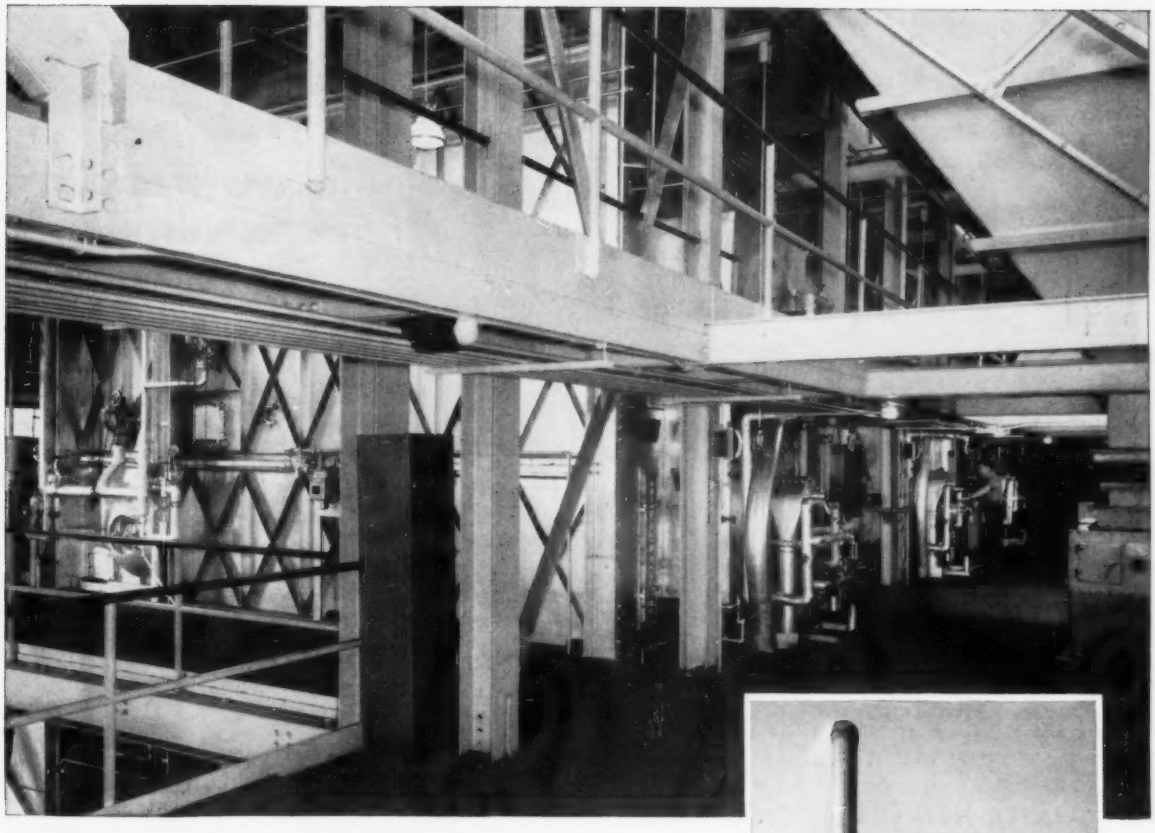
Write for complete information about these leading Harbison-Walker plastic fire brick.



Boiler furnace setting made of H-W PLASTIC FIRE BRICK. This monolithic construction is economical to build and gives excellent service under severe working conditions.

HARBISON-WALKER REFRACTORIES COMPANY AND SUBSIDIARIES

General Offices: Pittsburgh 22, Pennsylvania



FIELD REPORT: ESSEX COUNTY HOSPITAL

3 Union steam generators post 86.46% efficiency

75 buildings spread over 553 acres . . . nearly 4000 patients and 1300 employees . . . briefly, that's the physical size of New Jersey's Essex County Hospital Development.

Consisting of two complete divisions — Overbrook Hospital and the Tubercular Sanatorium — the institution relies on three Union Type VO Steam Generators as its sole source of heat and power. Steam is dependably produced to drive a pair of 1000 KW turbine generators, to heat all buildings (some are a mile and a half away), to power the hot water circulating pumps, and to meet cooking, water treatment and deaeration requirements.

With unit capacities of 50,000 lbs./hr. at 300 psig and 460° F, these 2-drum boilers tested out at 86.46% efficiency.

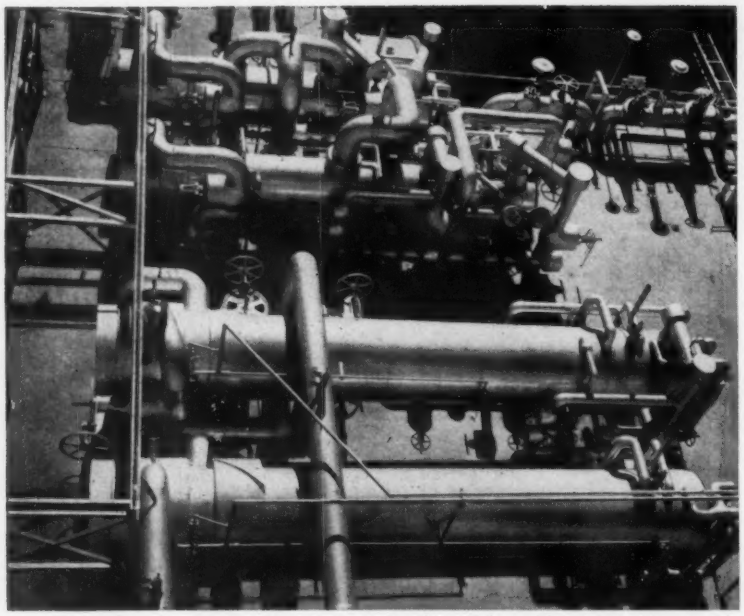
Across the nation, Union Steam Generators are providing dependable, low-cost steam for industrial, institutional and public power plants. Long engineering experience, skilled shopmanship and traditional Union quality are the unwritten specifications that assure their top performance.

FULL INFORMATION on the many types and sizes of Union Steam Generators is contained in illustrated Catalog GB-958. Write for your copy.

UNION

UNION IRON WORKS

ERIE, PENNSYLVANIA



Consulting Engineers, Ebasco Services Incorporated

The modern, efficient equipment shown here was designed and built by the Yuba Heat Transfer Division for the Collin Station of the Texas Power & Light Co. Serving a 110,000 KW turbine are five Yuba feedwater heaters, of which four are shown here. Two high-pressure heaters are designed for 2600 psi on the tube side with 6500 and 6750 sq. ft. of surface. Three low-pressure heaters are designed for 400 psi on the tube side and have 2850, 3165 and 4670 sq. ft. of surface.

FEEDWATER HEATERS . . . Yuba designed and built the *first* all-welded feedwater heaters, in service for the last year and a half. The weld technique was used in the tube bundles, shells and Multilok Closures. These all-weld heaters have started an industry trend.

CONDENSERS . . . Yuba is building condensers having 200,000 sq. ft. of total surface. The designs are readily adapted to condensers of even greater capacity as required for larger turbines.

EVAPORATORS . . . Yuba evaporators have achieved boiler make-up water purity of less than .2 ppm. Yuba can *guarantee* purity of .25 ppm solids content per 3000 ppm shell concentration.

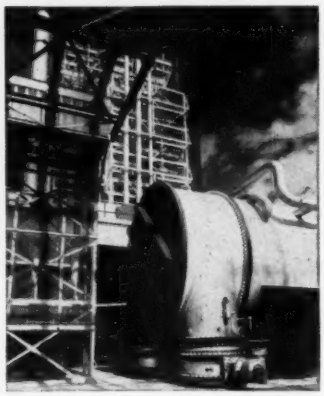
Engineering accomplishments such as these keep the power industry up-to-date. There's progress in power through progress in heat transfer equipment.

For information on Yuba power equipment contact
YUBA HEAT TRANSFER DIVISION
Honesdale, Pa.

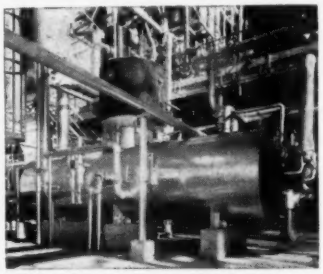
YUBA

EQUIPMENT will still be UP-TO-DATE TOMORROW

...because it's ahead today



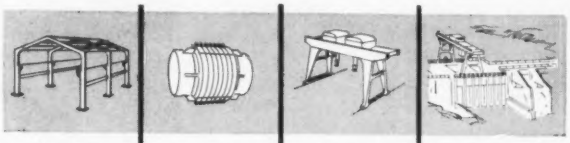
Twin-unit surface condenser has 90,000 sq. ft. of surface. Operates at 26.52 inches of vacuum with oxygen content in the condensate less than 0.01 cc per liter.



Bubble-tray evaporator produces 34,000 lb./hr. of vapor well below 1.0 ppm total solids with 3000 ppm concentration.

YUBA CONSOLIDATED INDUSTRIES, INC.

OTHER YUBA PRODUCTS FOR THE POWER INDUSTRY



Structural Fabrication | Expansion Joints | Cranes and Hoists | Hydroelectric Equipment

YUBA

TELETAX* TELEMETERING

engineered for the most advanced transmission techniques

TELETAX RECEIVERS

Teletax Receivers include: Single or Dual Receivers; Multi-Record Receivers for recording up to 6 separate measurements on one chart; and Teletax Receiver-Controllers for automatic operation. And the Teletax signal can be simply converted to digital information.

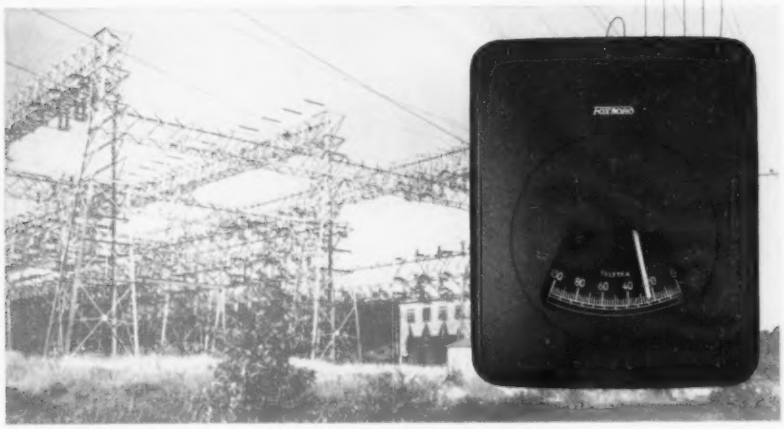
Telemetering matched in performance with famous Foxboro instruments — that's the Foxboro Teletax Telemetering System.

Through use of impulse-duration signals, Teletax electrically transmits measurements of a remotely-located variable to the central control station. Here, the Teletax receiver records the duration of impulse, which is directly proportional to the measured variable.

The Foxboro Teletax System is noted for its simplicity, its versatility, and its high sustained accuracy. For a transmission medium, it can use either AC or DC, an audio frequency carried on a transmission line, or radio or microwave impulses. Sustained accuracy is 0.5% of full scale.

TRANSMISSION LINK

With Foxboro's Teletax Telemetering System, you can use the most advanced transmitting techniques: two wire lines, power lines, radio or microwave. As many as 25 different signals can be handled in each direction, simultaneously.



TELETAX TRANSMITTER

The Teletax Transmitter houses either one or two standard Foxboro measuring elements — plus the Teletax transmitting mechanism. It will transmit to a control center hundreds of miles away just as easily as to one nearby. It also indicates or records locally if desired.

The Teletax Transmitter needs no periodic maintenance whatever, while the receiver requires only occasional oiling. And the receiver has a minimum of mechanical components to wear — no clutch to slip or jam.

Foxboro Teletax Systems are now in wide use on power plants, natural gas systems, water works, oil fields, steel mills, etc. Write for Bulletin 17-11C — it gives all the details. **The Foxboro Company, 689 Neponset Avenue, Foxboro, Mass.**

Reg. U. S. Pat. Off.

FOXBORO

REG. U.S. PAT. OFF.

TELETAX TELEMETERING

POWELL

world's largest family of valves

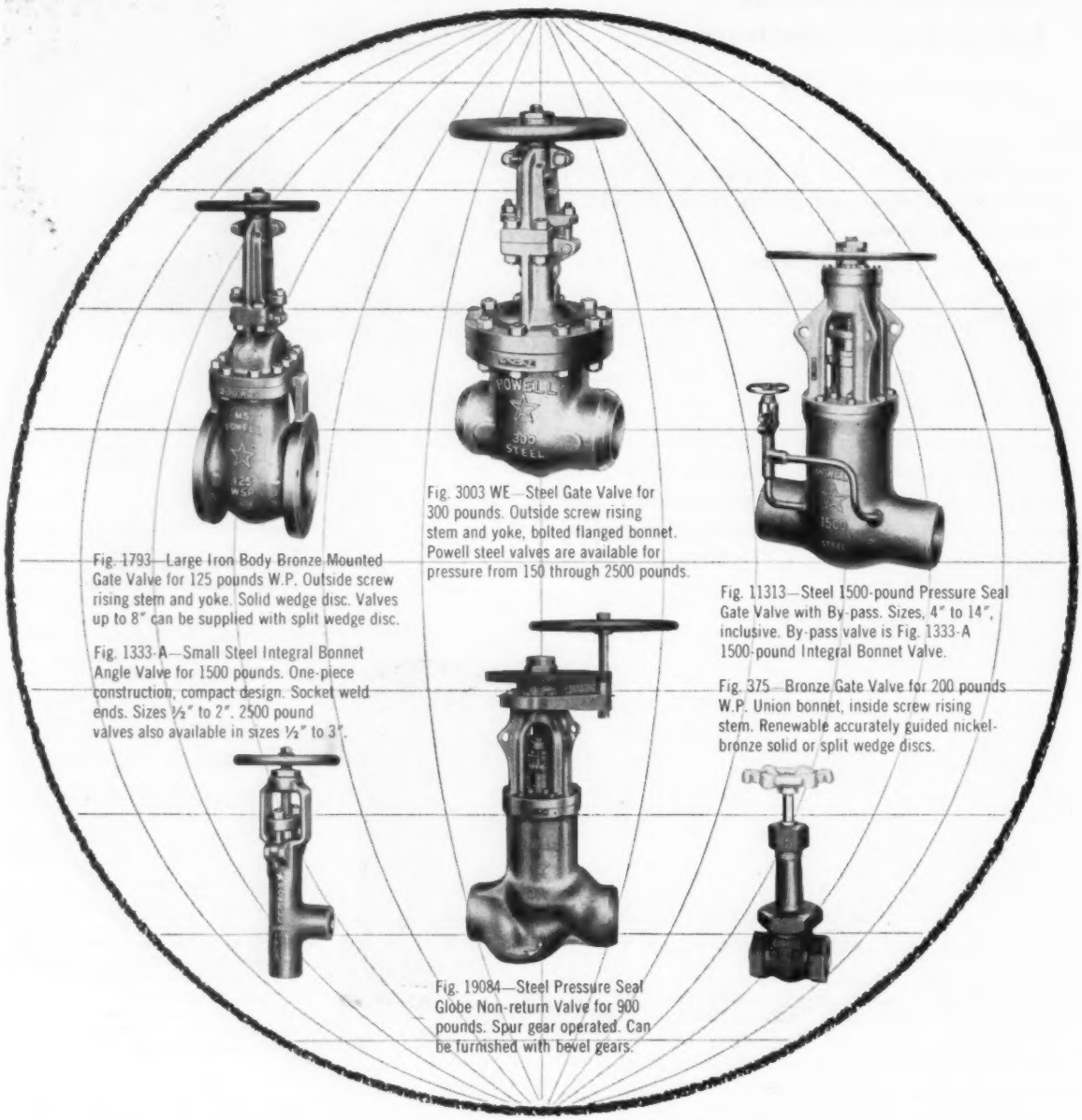


Fig. 1793—Large Iron Body Bronze Mounted Gate Valve for 125 pounds W.P. Outside screw rising stem and yoke. Solid wedge disc. Valves up to 8" can be supplied with split wedge disc.

Fig. 1333-A—Small Steel Integral Bonnet Angle Valve for 1500 pounds. One-piece construction, compact design. Socket weld ends. Sizes ½" to 2". 2500 pound valves also available in sizes ½" to 3".

Fig. 3003 WE—Steel Gate Valve for 300 pounds. Outside screw rising stem and yoke, bolted flanged bonnet. Powell steel valves are available for pressure from 150 through 2500 pounds.

Fig. 19084—Steel Pressure Seal Globe Non-return Valve for 900 pounds. Spur gear operated. Can be furnished with bevel gears.

Fig. 11313—Steel 1500-pound Pressure Seal Gate Valve with By-pass. Sizes, 4" to 14", inclusive. By-pass valve is Fig. 1333-A 1500-pound Integral Bonnet Valve.

Fig. 375—Bronze Gate Valve for 200 pounds W.P. Union bonnet, inside screw rising stem. Renewable accurately guided nickel-bronze solid or split wedge discs.

A solution for every kind of flow control problem is as near as your local Powell distributor. Powell valves are designed and engineered in the largest variety of metals and alloys, to handle any medium, every flow control requirement. There are Powell distributors in all principal cities. Or, if yours is a special engineering problem, write to:

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

LOUIS N ROWLEY, EDITOR • SEPTEMBER • ESTABLISHED 1882 Power

Research builds your future

RESEARCH, of a singularly misguided and fruitless sort, was carried out by the alchemists of the Middle Ages. In more modern times, it was by painstaking development that Edison produced a commercially successful incandescent lamp. As a matter of fact, for every scientific discovery or invention that resulted from inspiration, history records scores that grew out of protracted investigation. Why, then, all the current talk about research and development, the "R&D" of Congressional debates, of news reports, of business conferences, of cocktail conversation?

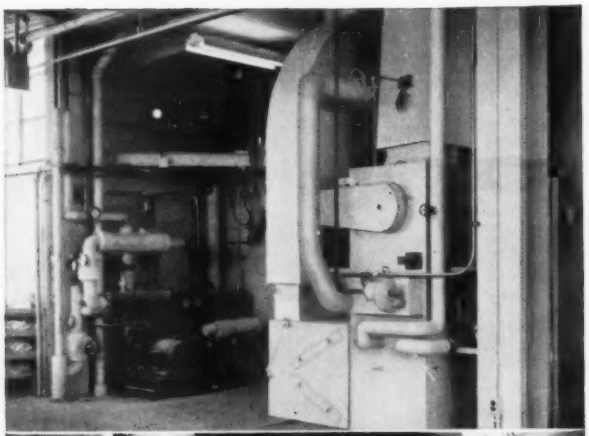
Well, for one thing, there's a lot *more* research being done than ever before in world history. In addition to vast government expenditures, U.S. industry alone invested more than $7 billion last year to discover and develop new products, processes and equipment. And the 1958 figure, despite a "recession," will probably run at least 10% higher. But the most important aspect of today's research picture can't be measured statistically.

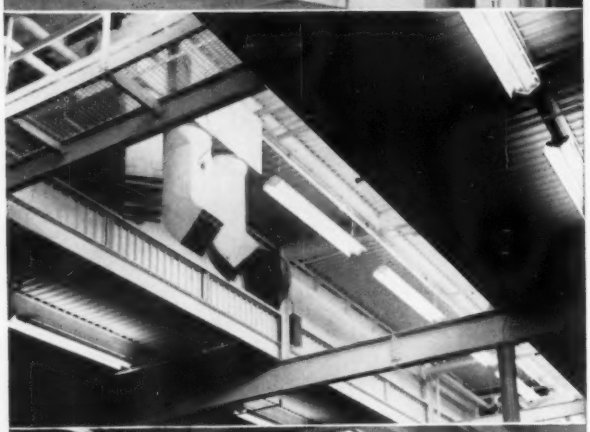
What we are seeing today is the culmination of a gradual change in the total concept of research. Once it depended on the curiosity of the individual scientist, on the opportunity to exploit a chance discovery, on the need to solve an immediate problem. Now, however, curiosity is organized, curiosity is a part of the industrial way of life. Increasingly, progressive management views research and development as an integral and essential phase of operations and makes a place in its budgets for a continuing investment in the future.

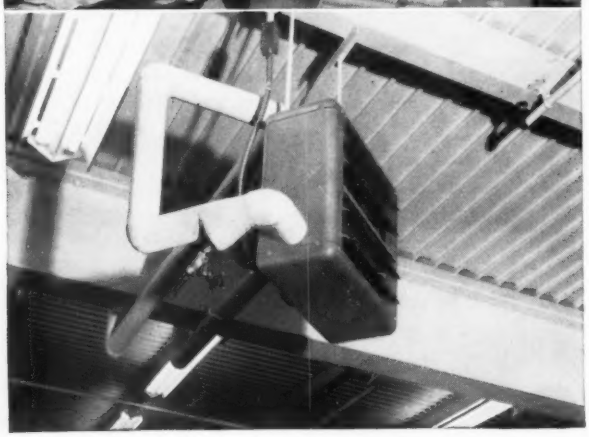
To all of us, this new concept of research and development promises much. New products create new markets; new processes and equipment increase our productivity. As McGraw-Hill's Dexter Keezer likes to phrase it, "R&D is a built-in burr under the saddle of the U.S. economy." With such a goad, the next burst of productive expansion may well come to be called the "R&D boom."

To us as power engineers, the new way of looking at, and using, research and development means more than just sharing passively in a growing national economy. When it comes to R&D, we are on the firing line. Some of us are directly involved in research or development activity, but all of us have a direct concern with its results. New products and processes make new demands on the services we provide, new equipment gives us the opportunity to provide them more economically.

The accelerating pace of technical progress puts an increasing premium on our alertness to see the possibilities of new methods, and on our skill and judgment in evaluating them. Technical advances will yield larger returns to companies and engineers who grasp their potentials, will more quickly make "also rans" of those lacking the vision and courage to accept the challenge of the new. In the R&D boom of tomorrow, the penalties will be great, but the rewards will be even greater.







At top left is one of many "Buffalo" Central Station Air Conditioning Cabinets installed in Adhesive Plaster Mill of new Johnson & Johnson plant. These versatile units can be used for cooling and dehumidifying, heating and humidifying and/or air cleaning.

Second photo shows vertically suspended down-flow "Buffalo" Lowboy Heating Units used in Shipping Center. Ideal for heating large floor areas, these quiet, highly efficient units conserve valuable storage or production space.

At extreme upper left of third photo is a quiet, compact, efficient "Buffalo" Type "NV" Propeller Fan installation in Baby Products Plant. These economical "package" units for either direct or V-belt drive are shipped completely assembled, ready for quick, easy installation. At upper center and right of photo are two more "Buffalo" suspended Lowboy Heating Units, described above.

At lower left is one of the numerous "Buffalo" Breezo-Fin Unit Heaters installed in Shipping Center. The heater element is a one-piece copper tube with square copper fins, spaced to give maximum radiation. There is no possibility of inside leakage. The motor mount is welded one-piece construction.

COMPLEX PLANT HEATING

The sheer statistics of this new Johnson & Johnson plant are impressive. Located on a 300 acre tract, its 635,000 sq. ft. of floor space extend for nearly half a mile. It uses more than 1,000,000 watts of lighting, sufficient for a community of more than 900 homes. The complexity of its heating and ventilating system is indicated by the fact that it utilizes over 26 miles of piping.

"Buffalo" equipment was specified for this complex heating and air conditioning job for many important reasons:

> First, the high quality of the equipment itself . . . the "Buffalo" reputation for dependability, efficiency, advance-design, economy of operation down through the years.

Johnson & Johnson's Newest: World's Largest Surgical Dressings Plant at North Brunswick, N. J.

Engineers and Builders: Walter Kidde Constructors, Inc.,
Mechanical Contractors: Richardson Engineering Co.,
Sheet Metal Contractors: Middlesex Sheet Metal Co., Inc.

& AIR CONDITIONING PROBLEM SOLVED BY "BUFFALO" EQUIPMENT

Second, the **completeness** of the "Buffalo" line of heating and ventilating equipment . . . the wide variety of types, models and capacities to fit every possible application need. In all, "Buffalo" products quietly and efficiently handle a total of 928,000 CFM and 53,167,000 BTU/HR in this ultra-modern plant.

Third, the "Buffalo" record of more than 81 years of engineering experience, combined with modern-as-tomorrow design.

These are the sound reasons why "Buffalo" equipment was specified for the new Johnson & Johnson plant. They add up to very sound reasons for **you** to specify "Buffalo" equipment. When you plan **your** next plant heating and/or ventilating installation, be sure to call on "Buffalo". Contact your nearest "Buffalo" Engineering Representative, or write us direct for full information.

A Vital Component of Every "Buffalo" Product is the "Q" Factor — the Built-in QUALITY Which Provides Trouble-Free Satisfaction and Long Life.

BUFFALO FORGE COMPANY

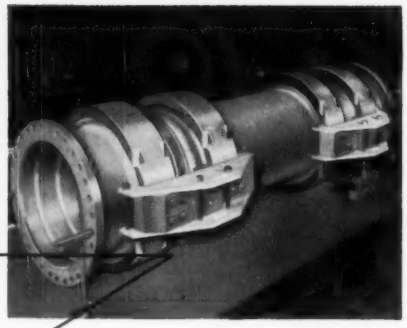
488 Broadway • Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd. • Kitchener, Ont.

Sales Representatives in All Principal Cities

INDUSTRIAL EXHAUSTERS BELTED VENT SETS PROPELLER FANS "E" BLOWERS-EXHAUSTERS

ALL IN A DAY'S WORK at *Pittsburgh Piping*



Every Pittsburgh Piping job is different, but all are alike in one respect . . . to control the flow and harness the energy of high temperature steam, gases, or liquids at high pressures. It's all in a day's work at Pittsburgh Piping to fabricate piping for a central station, an atomic energy installation, or for industrial and processing operations. Our service includes every phase from blueprint through erection: engineering, metallurgical control, pipe bending, machining, welding, heat treating, inspection, and testing. Use these facilities on your high temperature, high pressure piping jobs.

this BIG 10-TON EXPANSION JOINT

36" carbon steel joint, weighing ten tons, for cross-over piping in central station.

and this small PRESSURE RISER CONDENSER

Pressure riser condenser, fabricated of Stainless Steel Type 347; 2 feet high; wall thickness equivalent to 4" Schedule 160S. Stainless steel pressure vessel, for atomic energy application, appears in background.

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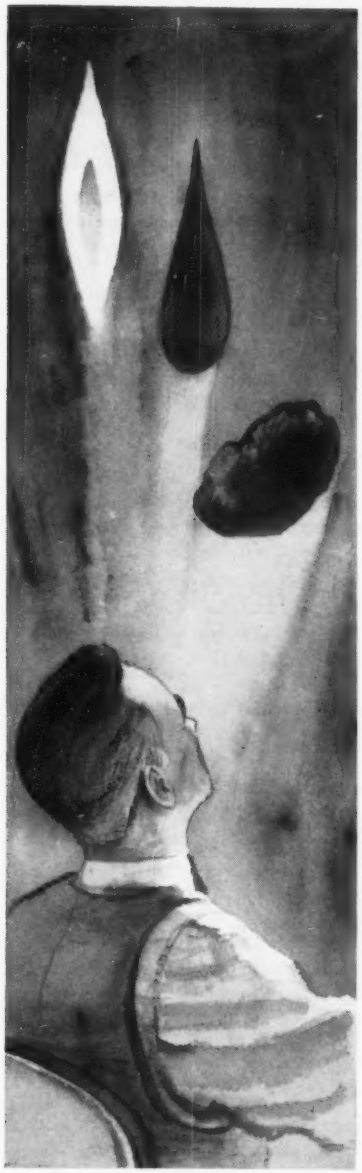
Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge



Fuels: A look ahead

- Coal surges ahead as the major energy source for power generation. Stable price and plentiful supply will make coal use pay in many new areas by 1965
- Gas will invade oil regions of Florida, N Pacific Coast. Availability and transmission costs will retard growth
- Byproduct fuels, wastes offer new supplies of power for industrial use; new savings in plant operating costs

By L E STEWART, Assistant Editor

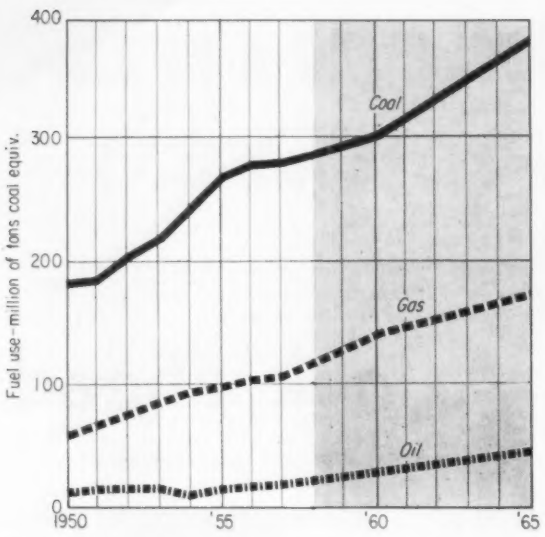
Power engineers who must choose a fuel today and live with it for years to come are faced with a rapidly changing picture. Skyrocketing demand during the next few years will put added emphasis on transportation costs, and each fuel's share of the market is expected to change considerably. The power man wants to select a fuel system which suits his particular needs. He must choose, and justify, a single- or multi-fuel plant based on delivered price per Btu and the relative cost of in-plant handling.

Special waste fuels and lower grades of conventional ones are available to the power man prepared to take advantage of them. Power plants laid out with an eye to future fuel switching must be carefully designed with many of tomorrow's operating problems allowed for in the design stages. Keeping this in mind, our report summarizes the overall price picture through 1965 and spotlights some characteristics you should know.

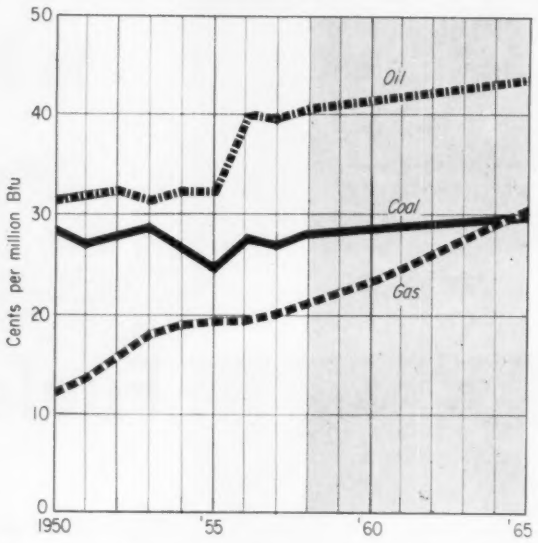
Fuel demand and price figures for the next few years forecast a swing back to coal as the major source of power. Coal will expand its share of total power generation from 50 to nearly 61% during the next seven years. Increased demand in the power industry goes hand in hand with an expected price stability for this solid fuel over the next ten years. Improvements in mining methods will effect savings in mining costs, and are expected to overshadow reasonable increases in labor costs through 1970. Turn page

Perforated for your filing ease

Average price and consumption estimates indicate significant changes ahead



FUEL CONSUMPTION curves soar as population, business growth need more power. Coal will grab lion's share of overall demand



FUEL PRICES forecast more competition between coal and gas as oil maintains price differential. Figures are national averages

Natural gas is a different story. The price trend for gas is up sharply. With this trend expected to continue, gas may cost 50% more in 1965 than it does today. Well-head prices are continually rising, and increased demand for gas, both as a power fuel and for heating and home service, will up transportation costs some 25% by 1965. In spite of increased storage areas and adequate reserves, this cost picture indicates that the tremendous growth of gas as a boiler fuel will go on at a slower rate in years to come. In fact, rapidly expanding underground storage facilities will eventually spell the end for dump or offpeak gas burning. Underground storage near consuming areas supply an average of 50% of the local peak demand so gas companies will find it more profitable to pump to storage than to sell gas at dump rates for power generation.

Oil picture for supply and demand is similar to gas with the exception of the price premium already paid for oil in many parts of this country. Oil reserves are more than adequate through 1975, but demand for premium petroleum products will force oil out of many power plants. Residual fuel oil amounts to some 15% of domestic-refinery output, and process requirements limit this figure. At present, 50% of all residual fuel oil used in this country is imported as a finished product. Net result will be steadily rising oil prices. For the long-term planner, oil's price premium will affect its use everywhere but the Pacific Coast by 1965.

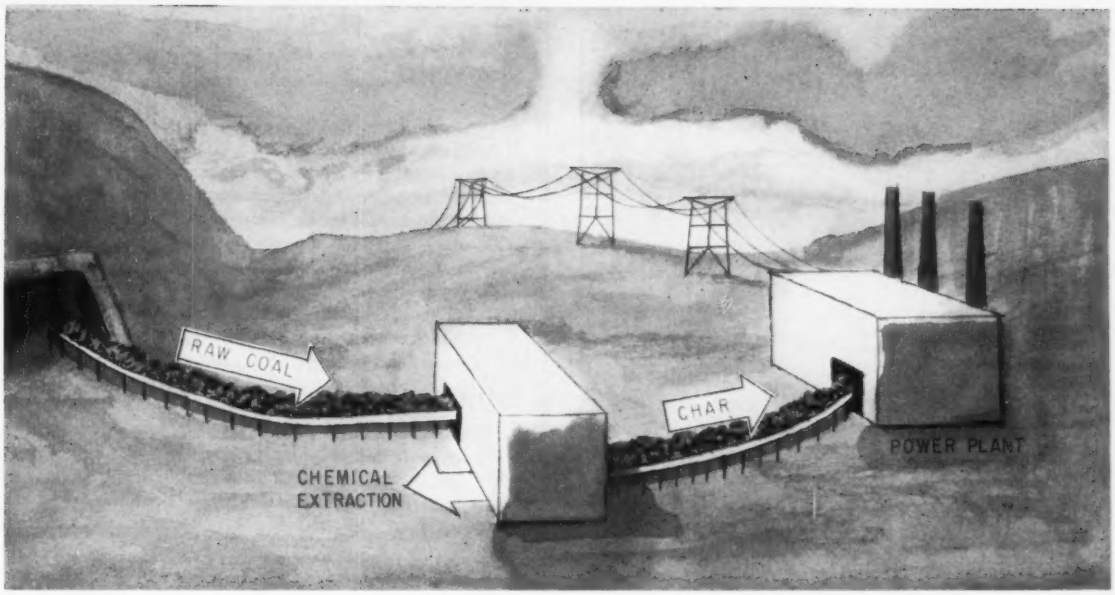
Special fuels and nuclear energy amount to less than 2% of the total industrial consumption. Of this small amount, waste fuel, including blast-furnace gas, coke-oven gas and black liquor, are the biggest part. Nuclear energy use will increase, but economical atomic power generation will still be a marginal item in 1965.

Regional price in cents per million Btu

	1957			1965		
Area	Coal	Oil	Gas	Coal	Oil	Gas
New England	39	43	42	45	59	54
Middle Atlantic	30	41	31	34	49	42
South Atlantic	28	41	22	31	50	35
East South Central (Ky., Tenn., Miss., Ala.)	19	—	19	22	—	26
West South Central (Tex., Okla., La., Ark.)	—	—	11	—	—	19
East North Central (Ohio, Mich., Ind., Ill., Wis.)	27	—	22	29	—	30
West North Central (Minn., Iowa, N. D., S. D., Neb., Kan.)	25	—	21	30	—	31
Mountain	21	—	24	24	—	31
Pacific	—	31	26	—	43	35

Regional prices are shown in table, above. Your particular power fuel-cost story will depend on your plant's location. Coal figures listed are totals of anthracite, bituminous, subbituminous and lignite. The oil totals are made up of residual oil, heavy oils and lighter grades used in some industrial plants. Gas price and consumption figures for 1965 may include some synthetic gas produced in the New England and Middle Atlantic states to be used in "peak-shaving" operations.

Sources for curves and table: McGraw-Hill Department of Economics, American Gas Association, American Petroleum Institute and Bituminous Coal Institute



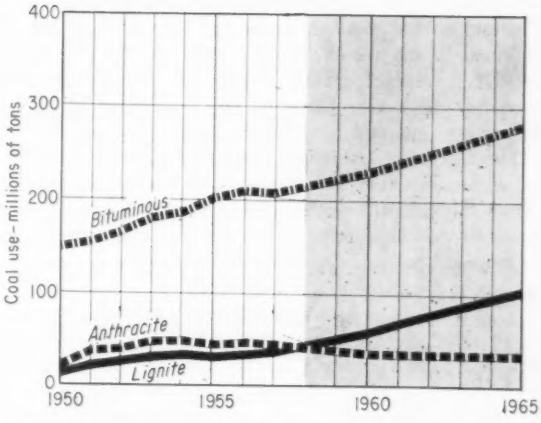
CHAR BURNING gets a boost with utility plant tied directly to chemical-extraction plant. Coal flows from mine-head processing section to chemical plant. Solidified char rides belt to boiler hoppers, can mix with bituminous to maintain ignition stability

Coal stretches its lead as a power fuel

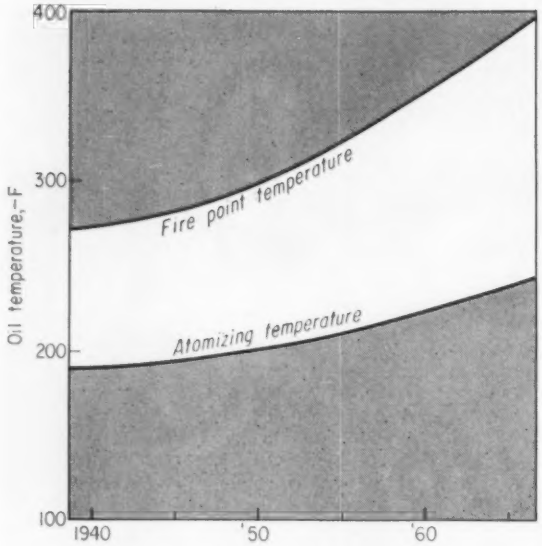
Where coal is king, the power man still has to evaluate the various types available to him. In many sections of the country several grades of anthracite, bituminous, subbituminous and lignite coal are available. Manufacturers of fuel-handling and firing equipment have developed ways to burn low-grade or problem coals, and improved processing and handling can produce a more uniform fuel. This allows firing of coals which, if not carefully processed, could not be used.

A sidelight in this story concerns industrial plants equipped with anthracite stokers. Several plants have found they can burn strip bituminous without modifying firing equipment, and these plants now take advantage of price swings between coals. One caution: anthracite hoppers may not slope enough for bituminous coal, causing rat holes and bridging in old hoppers.

In breaking down overall coal-consumption figures we find bituminous coal will keep the lion's share of business. Anthracite firing is expected to decline somewhat through 1965, while subbituminous and lignite use will grow as power needs in Mountain states and the West North Central area increase. Several utility stations now operate with pulverized lignite as primary fuel. Power men are also watching results of initial operation in plants burning coal char. Continued success of char operations should increase the call for this new fuel in the bituminous-coal region. Char may be burned on chain or traveling-grate stokers of the anthracite type, or in cyclone furnaces without supplemental fuel. Pulverized firing needs high heat, turbulence and possibly auxiliary fuel. One utility power plant is sketched, above, as an integrated picture of mining, processing, chemical-extraction and final power phases.



COAL CONSUMPTION curves indicate steady growth for lignite and bituminous. Anthracite loses out to strip-mined bituminous



OIL TEMPERATURES for Bunker C reflect trend to higher atomizing, burning temperatures. Careful operation minimizes effect

Synthetic gas will supply

Synthesis gas will be an increasingly important part of total supply in years to come. Gas transmission costs are rising in the North Atlantic states to the point where manufactured gas can compete for peak demand. Some New England gas companies consider so-called peak shaving justifiable today, and by 1965 peak shaving should be a standard procedure. The peak-shaving operation consists of supplying the gas demands above base-load requirements with synthesis gas. This results from the price premium paid for gas during load surges. Result for you: increased availability of gas for power generation, but at much higher prices per million Btu.

Several synthesis methods are available today and others are well into development stage. At present, peak-shaving in New England would depend on use of oil gas generators for the first

Oil use hinges on imports and residuals;

Oil firing presents a picture similar to coal, of consumption of a base block of standard grades coupled with use of some high-viscosity or heavy-residual oils and tars where possible. Increased emphasis on special residuals is a result of the price premium for oil. Competitive markets for bulk use of oil are in the New England and Pacific Coast regions, with Florida swinging first to gas and later to coal as an alternate for oil.

The fuel-cost picture for industrial users is modified by a fuel-handling cost lower than coal's. In smaller plants the cost differential in fuel firing, handling, storage and ash equipment often justifies price premiums of ten cents per million Btu. Then fuel oil is competitive with coal along the entire Atlantic Coast.

High-viscosity oils and tars can be burned by conventional atomizing equipment. The higher temperatures required in storage and for atomizing increase handling costs, but bulk use can result in overall savings. Fuels in this category are rarely transported any distance: supplies are limited to areas near refineries.

Petroleum coke is the final stage in oil residues. Produced by the delayed or fluid process, it has a variable volatile and moisture content. It can be burned on stokers, as pulverized fuel or in cyclone furnaces. Supplemental fuel is often needed for ignition.

Oil use consists primarily of No. 5 and 6 grades, or so-called Bunker C. Classification for domestic products is usually very specific, but foreign classifications are often different and imported residuals vary greatly. Basic specs for oil should spell out flash point, fire point, viscosity and heating value. In addition, you should know the temperature required for oil atomization—usually equivalent to a viscosity of 20 Saybolt Seconds Furol (ssf). This is the minimum oil temperature you must have *at the burner*, not at the heater.

Atomizing temperature and fire point are important factors in ignition stability. The temperature difference between them represents heat which must be supplied in the furnace before ignition occurs. Operators who have difficulty lighting-off cold boilers should check their oil for these two temperatures; differentials over 200 F may give trouble. Curve, above, indicates a gradual rise in both the atomizing temperature and the differential as changes in refining methods cut deeper into heavy oils. The vast majority of today's fuel oils are blends of heavy ends and light cuts. Although oil companies keep close tab on the residual quality, the overall effect of refining-process changes has been a slow rise in fuel-oil viscosity since World War II.

Corrosion problems with oil firing are similar to coal, and stem from oil's sulfur and vanadium content. As with coal firing, high percentages of these elements combine to create extreme corrosion problems. The corrosive effect of sulfur in fuel is well known, and the presence of vanadium apparently produces the corrosive action at even higher temperatures. When you evaluate fuels containing significant amounts of sulfur and vanadium, allowance must be made for increased heat losses and maintenance. Stack temperatures must be above nominal dew point for a given sulfur content.

peak demand in coming years

demand block and l-p propane-air gas for final demand peaks. Heating value of gas produced varies from 1000 to 1035 Btu per cu ft. The l-p gas equipment can closely follow demand fluctuations, but oil gas generators need four hours to start up and so must carry a base block of demand during usual peak periods.

Coal gasification enters the picture as the bulk supplier of future synthesis gas. Research has concentrated on production of high-Btu gas or methane either by upgrading coal-derived synthesis gas or by direct hydrogenation of coal pretreated to destroy coking characteristics. H-t gasification offers the greatest promise so far. This process uses bituminous coal, steam and oxygen to produce gas. It also produces a high-carbon solid and waste heat which must be used in a combination steam generator-reactor to justify the process.

gas invades new areas

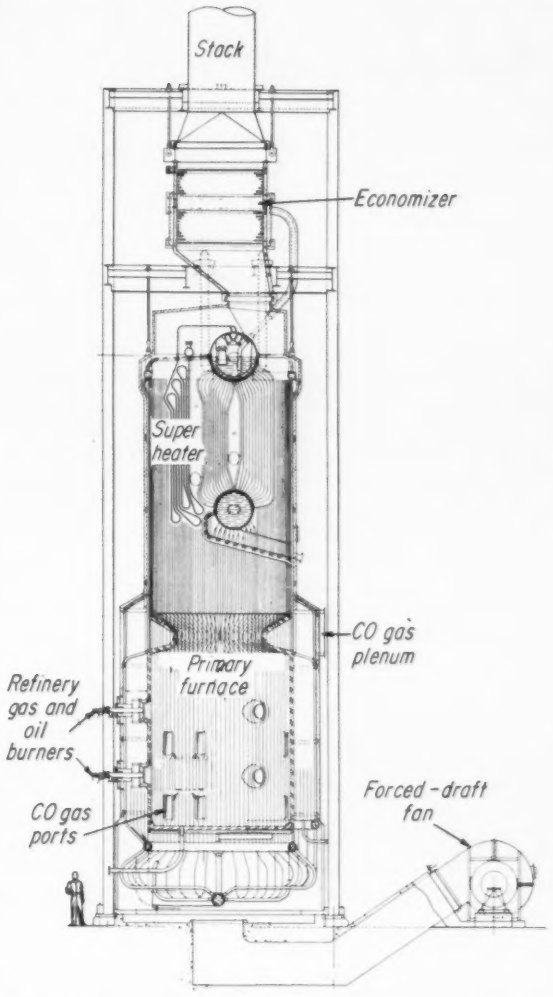
Natural gas use for power generation has skyrocketed since 1948, with good reason. Gas is almost the ideal power fuel: handling is easy, there are no storage problems and it requires minimum expense for firing and handling equipment. Sole drawback lies in the difficulty of supplying utility, industrial and home demand at competitive rates. At present new lines are scheduled to bring gas into Florida and the North Pacific Coast. Generation with gas will spurt in these areas for several years, but residential demand will begin to interfere by 1965. Gas-fired air conditioning plus underground storage commitments will almost dry up summer dump gas supplies. The gas industry expects air conditioning to increase summertime demand up to 50% in some areas.

For smaller power plants, gas firing will still be a good bet through 1965. However, the ability to fire a second fuel on a permanent basis is a must item.

Coke-oven and blast-furnace gas are important sources of fuel for the steel industry. In many areas the supply of gas justifies its use by neighboring plants on a dump basis. These byproducts of bituminous-coal coke vary considerably in chemical analysis and heating value, but both are extremely dirty as received. This common trait forces special handling in burning equipment. Burners require access for cleaning, and all boiler heating surfaces need extra provisions for soot blowing and washing. As with most byproduct or dump fuels, firing equipment must be capable of burning alternate fuels singly or in combination as fuel supply varies.

Refinery gases occupy a position in the petroleum industry approximating coke-oven and blast-furnace gas in the steel industry. Most refinery gas produced consists of volatile ends which cannot be used economically in product blends, and CO gas from catalyst regenerators. Surplus process gas may be available for dump use by neighboring plants, but supplies and gas analysis will vary with changes in refining procedure.

CO gas occupies a special position between a waste-heat source and a fuel. The gas is generated in the process of burning carbon off cracking-unit catalyst. Gases leave regenerator at about 1000 F and combustible content is 5 to 8% CO with a trace of hydrocarbons. They are fed to a special boiler with supplemental fuel where 100% of the heat of the combustible and about 50% of the sensible heat is removed—supplemental fuel is required to maintain ignition of the CO gas. The special use of a CO boiler is usually restricted to direct connection to catalytic-cracker regenerators, since waste-heat recovery is part of unit's economic justification.



CO BOILER represents one approach to problem of industrial gas utilization; fires refinery gas or oil as supplemental fuel

Special fuels

Fossil fuels usually dominate any discussion of use in power generation, with little or no consideration for so-called waste or byproduct fuels. The truth is that many industries are disposing of materials in a wasteful manner, while buying primary fuels at premium prices for steam generation. As the cost of basic fuels increases and waste disposal becomes more difficult, efficient use of process wastes *must* become more prevalent. Actually, the pure logic of conservation of natural resources requires use of all available waste fuels.

Aside from the reconstituted or modified fossil fuels already mentioned, several special waste products are burned in industrial plants. These include bagasse, bark, wood chips, vegetable wastes and paper-pulp process spent liquors. Chemical-recovery methods in the paper-pulp industry depend on burning spent liquor to justify overall process cost as well as to dispose of wastes.

Chemical recovery offers justification of whole processes in the paper-pulp industry. In a typical kraft-paper mill, prepared wood is cooked in digesters with steam plus sodium hydroxide and sodium sulfide. Liquid waste from these cookers contains transformed chemicals plus lignins and rosins from the wood. The spent liquor, containing 35 to 40% liquid, is sent to special boilers. Liquor is sprayed into the furnace, where it dries to a char and burning of lignins and rosins occurs. Process chemicals are tapped off the furnace base and reconstituted for use again in the cooking cycle. The black-liquor recovery boiler must operate as an integral part of the overall paper-mill cycle. It supplies steam requirements, and even uses sensible heat of the boiler exit gas to concentrate liquor for firing.

Bagasse burning represents a major improvement in operating savings for the sugar industry. This mass of cane fiber often accounts for most of sugar-refinery fuel requirements during the five or six months cane is harvested. Considerable quantities of the fiber are produced (about 60 million tons in 1956), making bagasse one of the major waste fuels. This fuel is normally burned in refractory furnaces, but is now being fired on spreader stokers with uniform feed requirements and a thin fuel bed. Bagasse contains about 50% moisture as fired.

Many other vegetable wastes, such as coffee grounds, corncobs, peanut hulls and so forth with up to 50% moisture content, are fired in a like manner on stokers or in refractory furnaces designed for pile burning.

Waste-wood burning takes many forms, depending on the size of particles and conditions of the feed. Wood chips containing up to 50% moisture today are often fired on spreader stokers. Paper-mill bark burning usually follows the pattern for wood chips or vegetable waste. However, one paper company installed cyclone-fired boilers for bark, coal, oil or gas burning. The proportions of bark and regular fuel vary with analysis of the fuels. This method of firing requires bark sizing and consistent, adequate feeding for stable ignition.

Nuclear energy represents a new and expanding era in power generation. Atomic-fuel consumption can only increase, but the rate of growth is anyone's guess. Cost figures for nuclear plants in operation to date would rule out economic power generation in any but the highest-priced fuel areas through 1965. The 60 mw unit at Shippingport Station is the only utility-sized nuclear plant now operating in the U.S. Present estimates of power costs run about 64 mils, eight times the national average. Since Shippingport is not running at full power the figures are misleading, but the most optimistic cost estimates run around 15 mils. This compares to a 5 mil cost for some new, conventional utility plants.

The ratio of capital costs for the two plants would run nine-to-one today, with eventual reductions resulting in atomic plants costing about three times as much as conventional ones. Presumably, the first competitive atomic power will be generated on the Pacific Coast or in New England. This competition will be based on lack of coal or gas as a steady fuel source and fairly remote plant sites requiring expensive oil storage.

The relatively low steam temperatures presently available from nuclear generators constitute a barrier to lower operating costs. Units destined for operation in the next seven years will raise the available steam temperature, but competitive nuclear power will still face the triple problem of low thermal potential, high fuel cost and high capital cost.

Thermonuclear plants may offer an eventual solution to the economic problems involved. However, the further development of this source must wait for a major scientific breakthrough. To date, scientists have not managed to reach the ignition temperature required for fusion. Final harnessing of this power source is too far distant to warrant estimates of operating costs.

Successful thermonuclear power generation may be 15 to 20 years away, and methods that will be used are still in the sketchiest forms. One problem which will need a lot of thought is the large amount of power the thermal reaction requires for sustained operation. Until this is solved, power ratings for a given capital investment will be lower than for today's nuclear plant.

General industrial use of nuclear or thermonuclear energy solely for power generation is many years away. Capital and fuel costs for an industrial nuclear power plant would be over ten times the figure for conventional fuel arrangements. However, the adaptation of nuclear energy to process chemistry may eventually result in sensible heat for a modified waste-heat cycle. This heat utilization is an important aspect of the continuing story of conservation of all energy resources, and should be uppermost in the minds of power-services operating men.

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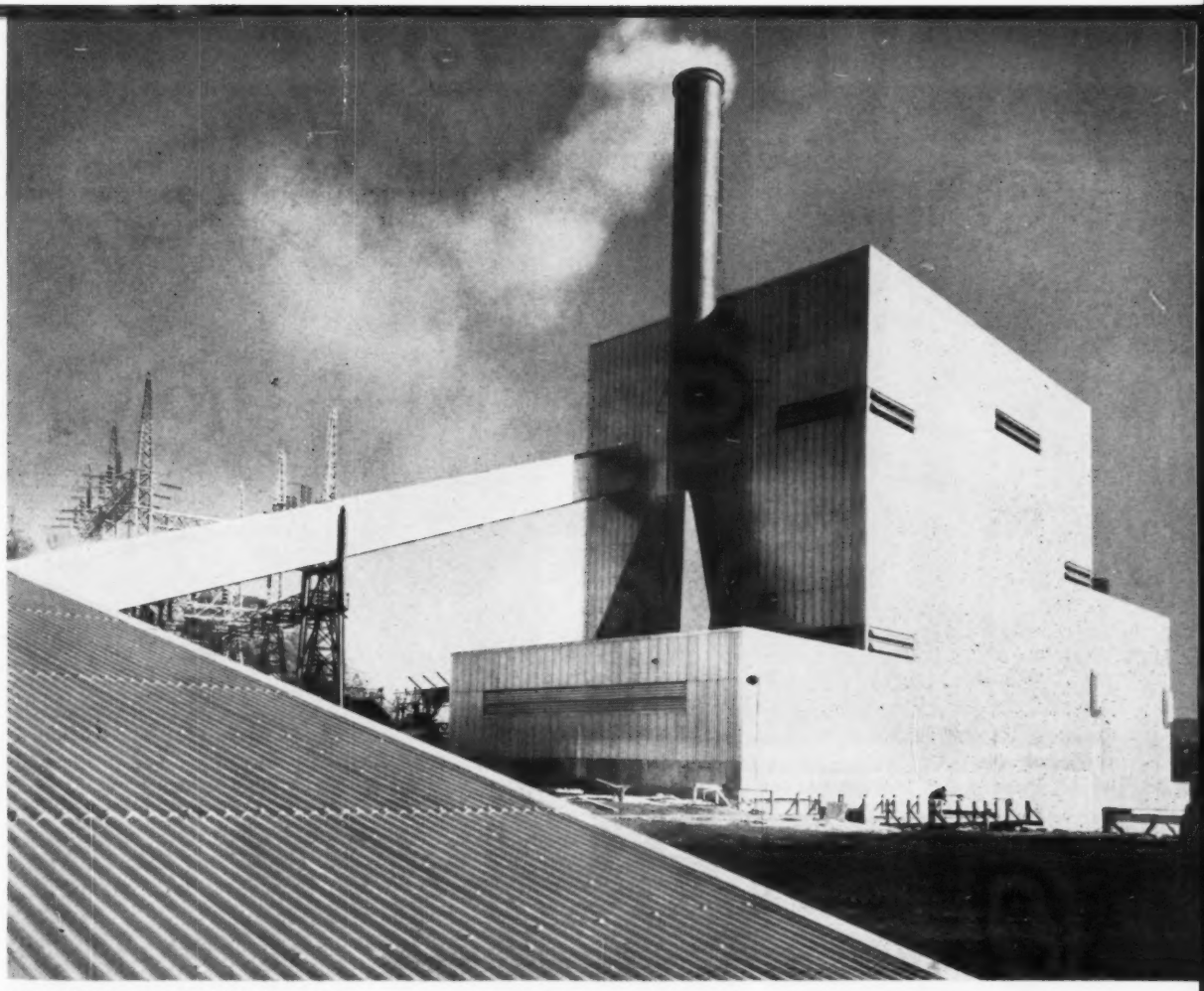


ARCHITECTURAL APPLICATIONS of aluminum are readily spotted. But behind shining walls are many new power-service uses

Aluminum: Central station heavyweight

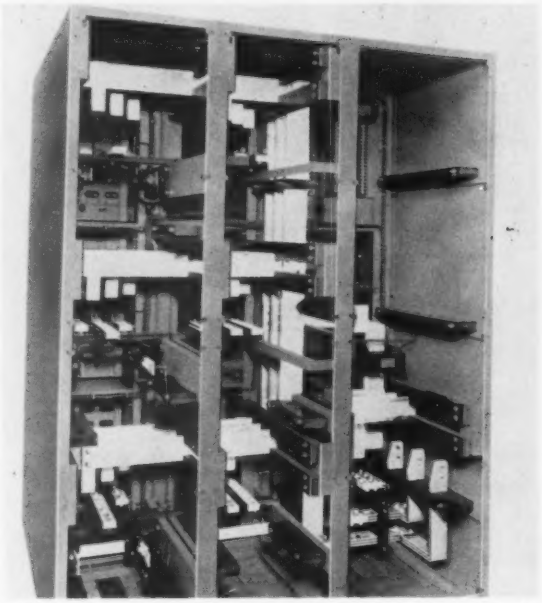
At a somewhat slow but persistent pace, aluminum in recent years has worked its way into the central-station designer's plans. On the following pages Alcoa cites typical ways the lightweight metal is currently being put to work, and profitably, in both electrical and mechanical power areas

This month's cover shows a shiny central station built a few years ago. It's the Morro Bay steam plant on the Pacific Gas & Electric system. Much of the plant's architectural interest has been achieved by the way fluted-aluminum facing has been applied to its intersecting forms. But the striking yet functional exterior tells only part of the story. Study the plans of most new central stations and you'll note the electrical and mechanical power areas offering a host of new uses for aluminum.

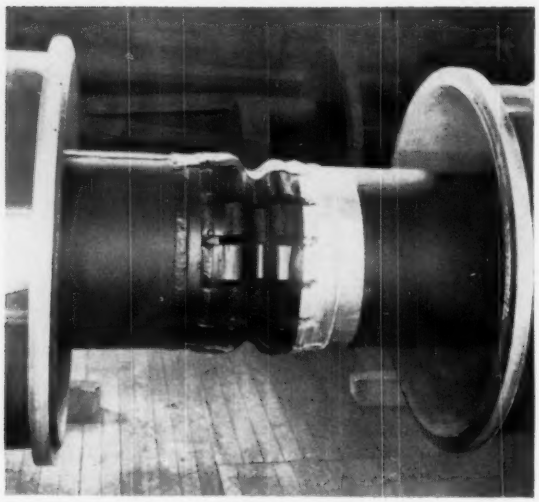
One case Alcoa points to with pride centers about a 425,000-kw steam generating station completed in 1951. This utility saved 56% on bus conductors plus 20% on fittings and installation costs. Reported savings through use of aluminum bus amounted to some 40%. Based on these savings, a second installation of 450,000 kw was completed in 1957 using aluminum bus in the outdoor sub and generator leads. Although there are many reasons why aluminum is moving into central stations, basic one is still straight economy. Info on next two pages is abstracted from an upcoming Alcoa booklet.

Turn page for details ►

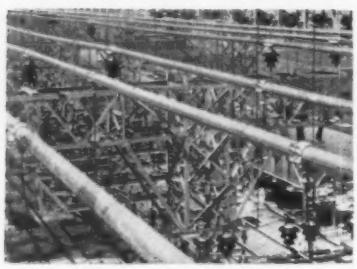
Electrical applications continue



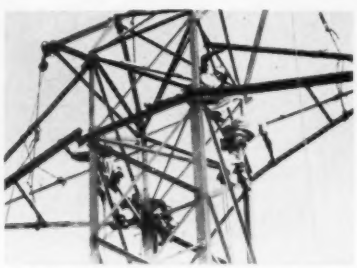
SWITCHGEAR built with aluminum bus, perhaps a complete aluminum enclosure when installed outdoors, has many advantages



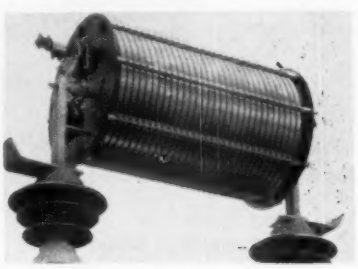
ISOLATED PHASE bus and housing, *above*, use the lightweight metal. Tubular conductor with 10,000-amp rating has 18½-in dia



HIGH-VOLTAGE BUS made from aluminum is finding its place in utility substations

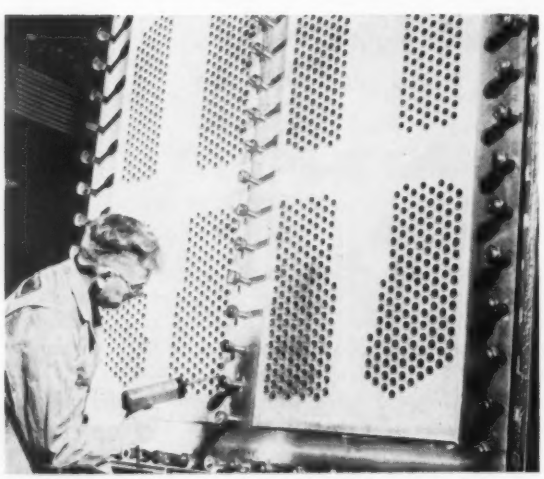


CROSSARMS of aluminum on galvanized-steel towers cut costs for Duquesne Light

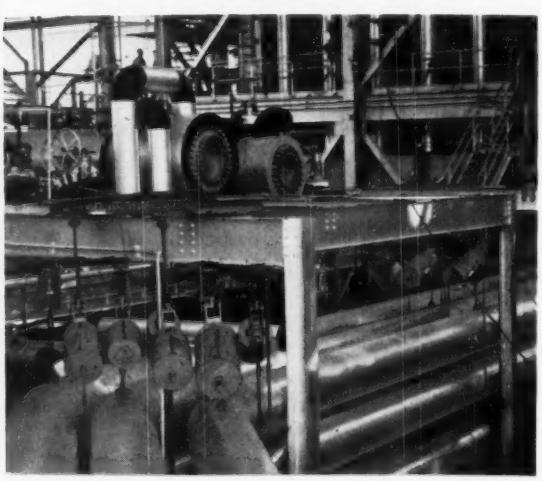


WAVE-TRAP conductors at 1200 amp are part of carrier-frequency blocking reactor

Mechanical uses hinge on competitive heat-transfer characteristics,

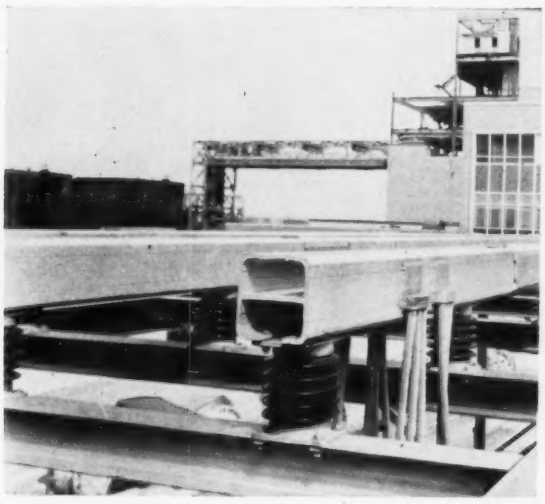


HEAT-EXCHANGE uses include feedwater heaters, hydrogen and compressed-air coolers. This 5300-sq-ft surface condenser is typical

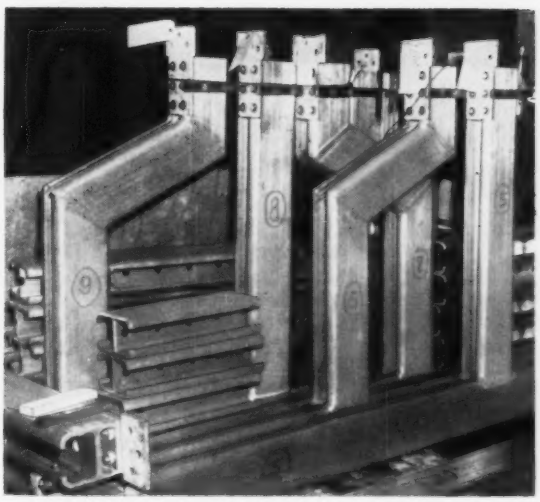


JACKETING with the lightweight metal is a step often taken after insulating: Suitable for gas, air ducts; piping; boilers

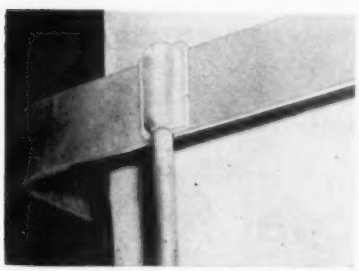
to grow, partially because of lower first cost, new joining methods



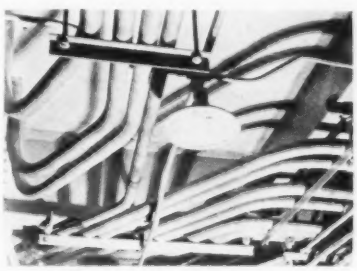
LOW-VOLTAGE OUTDOOR BUS runs to stepup transformers outside plant. Web channel, square, tubular, other shapes are used



LOW-VOLTAGE UNDERGROUND BUS on this job cost 37% the equivalent in square copper tube. Snap-on insulation is available



GROUNDING-BUS savings can run $1/ft. Copper lead is shown joined to aluminum

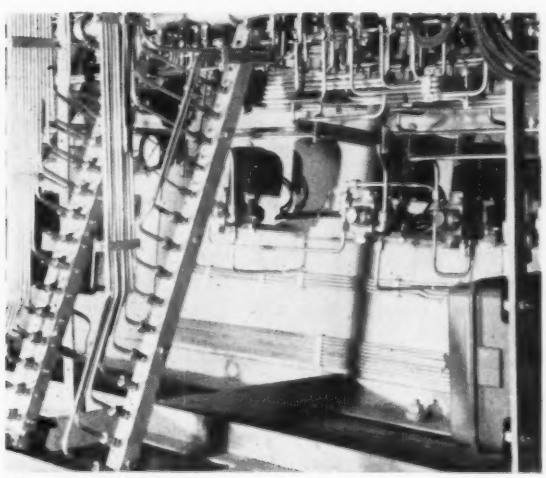


CONDUIT made of aluminum was installed in 1928 at Minnesota Power & Light Co

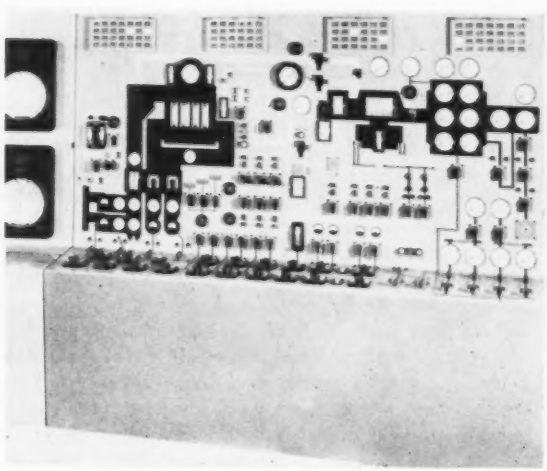
Welding aluminum

Jointing bugaboo was pushed further into background with recent development of a practical aluminum-welding technique. Using this process, cable, bus bar and tubing can be joined; aluminum to aluminum or aluminum to copper. Job requires a portable rig.

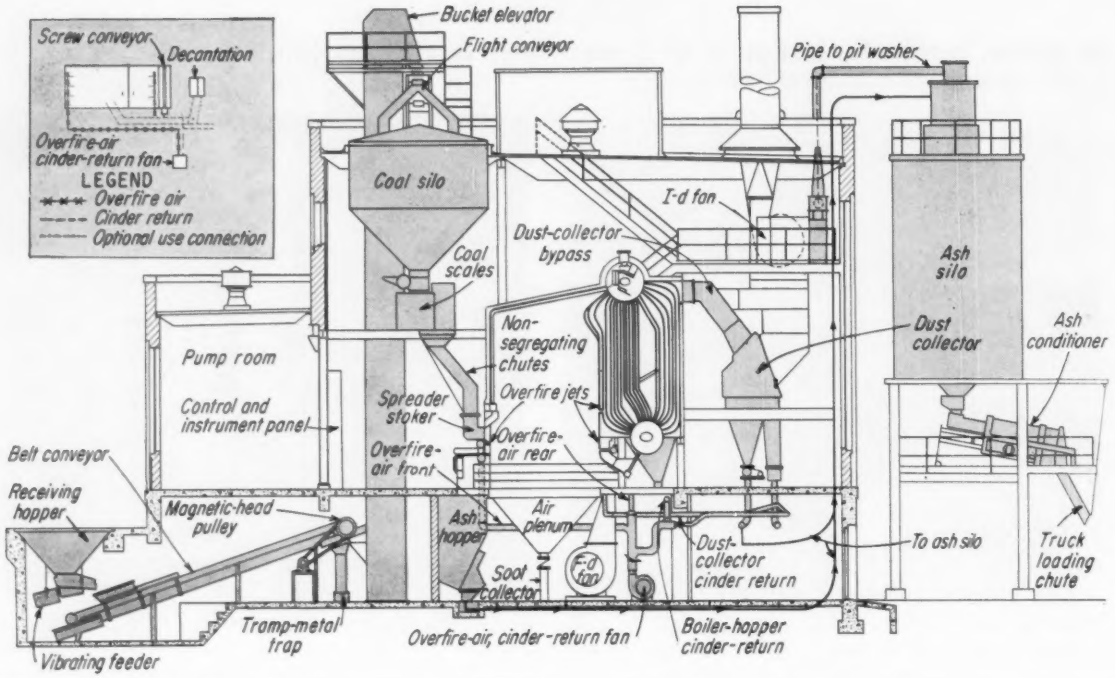
corrosion resistance, plus a 50% price advantage in some cases



CONTROL TUBING for meters and complete systems, either pneumatic or hydraulic, is available in single tubes, multiple bundles



CONTROL PANELS may be anodized in modern attractive colors. Nonmagnetic properties eliminate instrument compensation



COAL AND ASH-HANDLING systems are completely automatic, dust-tight. Steam generators are integral furnace waterwall units, 55,000-lb-per-hr capacity each, have automatic combustion control. Insert, *upper left*, shows setup of overfire-air, cinder-return system

Consulting engineers' comparative-fuel-cost study was major reason...

Why Wake Forest chose coal firing

Moving a 122-year-old college some 110 miles across country is obviously a task that isn't completed overnight. Ten years of progressive planning preceded the removal, in 1956, of Wake Forest College from near Raleigh, N.C., to its present location at Winston-Salem, N.C.

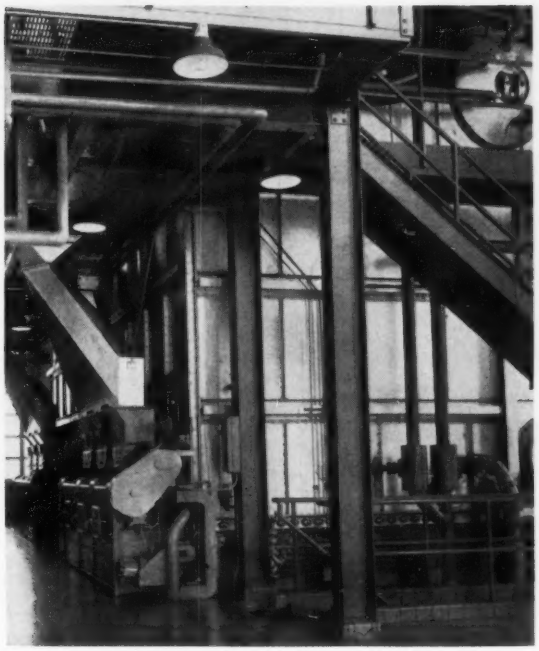
The school's new buildings were designed in the Colonial style that is so characteristic of the area and its traditions, and the architect's plans provided for no departure from this theme where the heating plant was concerned. In the academic setting, esthetics had to be considered as well as fuel economy and heating efficiency. Resulting integration of a modern, sparkling-clean coal-fired heating plant having high efficiency into this complex of stately buildings reflects close cooperation between architect and consulting engineers.

First step taken by the heating-plant design engineers was, logically, a survey of comparable fuel costs. Their preliminary report was based on high-grade bituminous coal priced at about $10 per ton, including a 1½-mile truck haul from the railway siding. Cost of the alternative fuel—No. 6 oil—was 7.26 cents per gal delivered, which was equivalent to $12.80 per ton coal. Natural-gas pipelines run into Winston-Salem, but service offered couldn't compete with coal. Concluding that coal would cost about 22% less than oil, the engineers designed the plant for multifuel use, but chose coal on basis of economy with heating efficiency.

Steam demand calculations considered not only normal seasonal variation, but well-defined plans for future expansion of college facilities. Initial peak winter load was calculated at 55,000 lb per hr and the summer load at 20,000. Contemplated expansion boosted these figures to 80,000 and 25,000 lb per hr, respectively. Because ultimate demand wouldn't be reached for a considerable time, steam-generating equipment had to be planned for operation at a fraction of its capacity. This meant selection of coal-firing equipment that would give satisfactory operation over a wide steam-demand range.

Satisfactory solution proved to be in the choice of two 55,000-lb-per-hr boilers to meet immediate demand and provision for future installation of a 25,000 lb per hr unit. When installed, this smaller boiler will handle anticipated summer loads easily, and a combination of any two of the three units will satisfy the eventual winter demand, leaving a third unit for emergency or standby service.

Steam generators are 2-drum, integral furnace waterwall units de-



BOILER ROOM INTERIOR is spotless, has tiled walls and floor. Overfire-air, cinder-return lines are shown forward of mud drum

Principal power-plant equipment

Steam generators, 2 — Erie City Iron Works
Two-drum, integral waterwall furnace, 55,000-lb-per-hr continuous, 250-psig design, 125-psig operating

Stokers, 2 — Detroit Stoker Co
Continuous cleaning spreader, 132-sq-ft area, equipped with 5-hp enclosed, fan-cooled constant-speed motor which drives coal feeder and oil pump for hydraulic grate drive

Forced-draft fans, 2 — American Blower Corp
22,300 cfm, 1200 rpm, 20-hp motor drive

Induced-draft fans, 2 — Buffalo Forge Co
40,000 cfm, 880 rpm, 60-hp motor drive

Overfire-air and cinder-return fans, 2 — Buffalo Forge Co
Exhauster type, 1500 cfm, 10-hp motor drive

Dust collector, 1 — Prat-Daniel Corp
Mechanical, multicyclone, decantation type

Combustion controls — Copes-Vulcan Div, Blaw-Knox Co

Soot blowers — Copes-Vulcan Div, Blaw-Knox Co

Instruments and meters — Taylor Instrument Companies

Boiler-feed pumps, 3 — Ingersoll-Rand Co
Centrifugal, 2 motor, 1 turbine drive, 3450 rpm, 150 gpm, 487-ft tdh

Feedwater heater — Cochrane Corp
Deaerating type, 30 psig

Coal-handling system — Beaumont, Birch Co
Vibrating feeder, belt conveyor, flight conveyor, bucket elevator, bunkers, scales, coal valves

Coal chutes — Stock Equipment Co

Ash-handling system — National Conveyor Co
Pneumatic, rotary ash conditioner, 20-ton silo

Motorized valves — Beaumont, Birch Co

Architect — J Frederick Larson

Consulting engineers — Wiley & Wilson

By J O LaPRADE, Power Plant Engineer

signed for 250 psig, but presently operating at 125 psig. Auxiliaries include completely automatic pneumatic combustion control, f-d and i-d fans and high-efficiency, mechanical-decantation type dust collectors with cinder-reinjection equipment. Boilers are fired by continuous-cleaning spreader stokers.

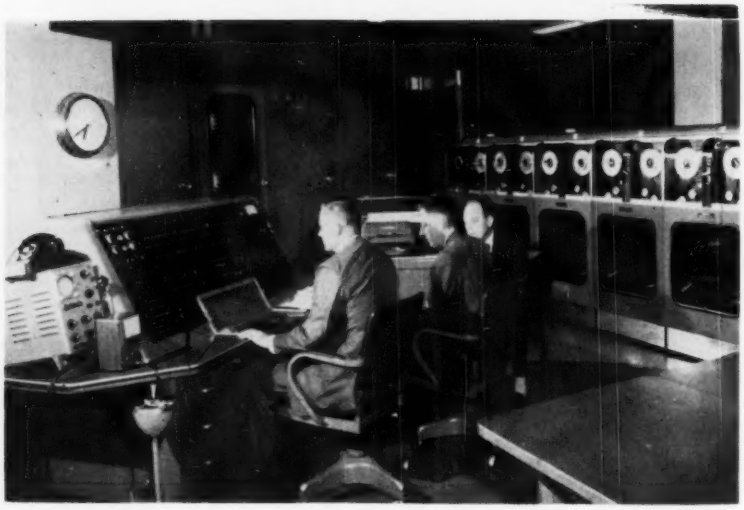
Overfire-air and cinder-reinjection systems for each stoker are served by individual exhauster type fans located in the basement. Each fan is driven by a 10-hp motor, and delivers 1500 cfm—equivalent to about 10% of total combustion air required. Screw conveyors, driven by 1/3-hp gearmotors, bring cinders from trough hoppers under the boilers to the sides of each boiler. These cinders, plus those from the dust-collector decantation hoppers, are pneumatically returned to the rear corners of the furnace. The overfire-air, cinder-return system fan also supplies two rows of overfire-air jets in the bridgewall, see inset drawing, upper left, facing page, for design details.

Design simplicity of the coal-handling system, drawing, facing page, is reflected in the low initial investment, and is paying off in minimum operating and maintenance costs. At present, coal is delivered by truck, but provision has been made for delivery by rail. A vibrating-pan feeder takes coal from the steel-receiving hopper and passes it to an 18-in. inclined belt conveyor operating at 210 fpm. A permanent-magnet head pulley on this unit removes any tramp iron. A continuous-discharge bucket elevator passes the coal from belt conveyor to a completely enclosed roller-flight conveyor. This carries the coal across the bunker tops and discharges into them. System capacity is 50 tons per hr when handling bituminous coal in sizes up to 3 in.

Individual overhead cylindrical-steel bunkers hold about 75 tons each, provide for 36 hr of peak-load operation or a 3-day supply under normal load. Coal flows from bunkers through roller-bearing-mounted, rack-and-pinion-operated gates to automatic scales that weigh the coal in 200-lb batches. Scales discharge at 10 tons per hr to conical nonsegregating chutes that give uniform distribution of fines and lumps across the stokers' full width.

Pneumatic ash-handling system is arranged to collect bottom ash from the boilers and flyash from the dust collector. System capacity is 10 to 15 tons per hr. An 8-in. main line serves the ashpits, with 6-in. branch lines to dust collector and sifting hoppers. Beneath the overhead 20-ton capacity ash silo, a rotary ash-conditioner unit having a 20-ton-per-hr capacity moistens the ash to eliminate dust nuisance during discharge. Silo is emptied about once a month into disposal trucks.

After more than a year of operation, the Wake Forest installation is performing according to design criteria. From the standpoint of clean operation, heating performance and labor saving, investment in high-efficiency equipment has been justified.



Computers speed pipe-stress studies

Designers faced a major roadblock in pipe-stress work: it took too long. So they devised methods aimed at computer use. Dividend is shorter time from boards to production

Reason for getting new approaches to pipe-stress work was simple: Past methods were just too time consuming to be economical.

Best known method of analyzing pipe stress is often called the classical approach. Although it enables engineers to do the job, it's cumbersome. The system involves inversion of large matrices (similar to determinants) that tend to get unwieldly in a hurry. Also, the calculations needed to find each member of the matrix are long and involved. You can get an idea of the work load designers are up against by considering that calculations required to invert one of these matrices (say it's an n x n matrix) is proportional to n^3. Since it's common for a matrix to have more than six unknowns (n equals six or more) it's easy to see the situation can just about get out of hand.

Limitations of the classical approach are serious. Not only is it a time-eating process, but the accuracy is not what it should be. To keep the work load within reason, the number of significant digits is often kept at some fixed number. When you do this, the number of significant figures that mean anything in the final result is less than what you start out with. In other words, if you limit intermediate answers to six meaningful digits, by the time you get the final answer perhaps only the first four numbers will be accurate. The rest are simply approximations having little meaning. Since accuracy tends to decrease as the matrix size increases, the trend of significant digits to drop out of the picture takes on a fair degree of importance. Furthermore, the math setup of the classical method doesn't lend itself to plugging into a computer. So, even though fast-working machines are available, they aren't much help.

Joint research by Blaw-Knox Power Piping Division and Arthur D Little, Inc, produced a method of stress analysis that lends itself to complete computer processing. They re-examined the basic principles of stress calculation and came up with a matrix that has no more than six members throughout the approach (called the "6x6 Flexibility Matrix Method.")

Big advantage of the system is time savings. As much as a month can be devoted to complete a stress problem. But, by use of this newer method time can be cut to one day.

Data fed into the computer consist only of dimensions lifted from isometric drawings of piping system (see facing page), and some of the pipe material properties. These data are first tabulated on simple forms. Figures are taken from these and fed on to a standard input medium.

Calculation time taken by the computer is less than an hour. Total time required includes putting data on tape, checking accuracy of transcription, putting tape through computer and getting a tabular readout.

Results obtained through the machine can be maintained at a high degree of accuracy. Computer will detect inconsistencies in input data and inform the operator of these errors. If permitted, the computer will substitute correct dimensions automatically. Accuracy of results is

limited only by preciseness of input data and number of significant figures machine can handle. No shortcut approximations must be made, since all complicating factors and special variables can be considered.

Any number of anchors and restraints can be included in the analysis. Out-of-plane bends as well as restraints are processed regularly. The number of free ends and junctions has no effect on the accuracy or efficiency of the computer analysis. Floating headers, with the calculations going back through the superheater tubes to the boiler restraints, can also be considered.

Looped systems, in which steam flow passes from one pipe into two and back to one again, are typical of systems involving these factors. Latest experimental and theoretical results on flattening of bends caused by in-plane and out-of-plane bending are also included in the computations.

Mathematicians are about the only ones who can appreciate the math roadblock overcome by the computer technique. But anyone can realize one other important advantage. Normally when a member of the pipe system is to be changed you have to run computations back through the system till you reach a support. Using the computer method, this process is no longer necessary. Results at hand for the unchanged sections can be plugged in along with new data on the altered section. You don't have to recalculate the whole thing.

Costwise the method saves engineering man-hours. But shortening the time necessary to figure a system also shortens the time needed to get equipment off the boards and into production. This is the savings that is significant, making computer analysis of pipe-stress systems worth the effort to achieve.

PLAN '59 *Modernize now for growth and profits*

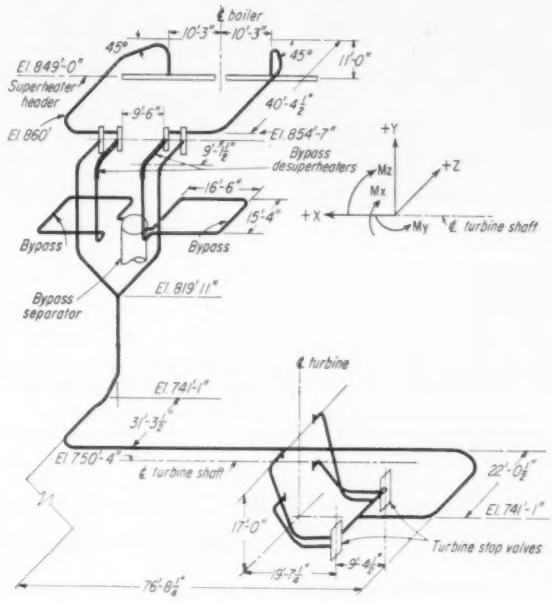
POWER's Plant Design Issue will be ushered in next month. It will be our contribution to the *McGraw-Hill PLAN '59* editorial program aimed to show how industry and all America can benefit by modernization of plant and equipment. Watch for it!

How to get answers with a computer:

- Make an isometric piping diagram
- Jot down steam conditions, pipe properties
- Plug data from above into computer, get results

Metal expands over nine inches per hundred feet in piping shown, below. Highest expansion stress was over 8000 psi. If you don't consider these conditions, something will give. Getting these answers used to be a real task. Now, with computers and a fresh approach, what used to take days is done in hours.

Basic dimensions are obtained from schematic



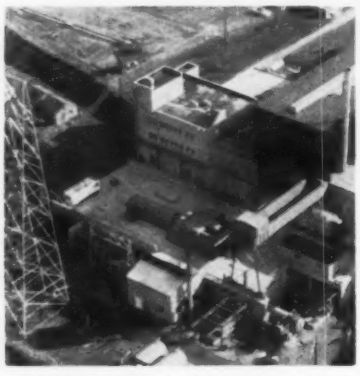
Steam conditions, metal properties

Main Steam
Sizes: 18 in. OD, 3.375 in. nominal wall (3.625 in. minimum)
14 in. OD, 3.125 in. nominal wall (2.875 in. minimum)
Material: ASTM Specification A335 Grade P-22
(2¼% Chrome, 1% Molybdenum)
Design conditions: 2600 psig, 1060 F (maximum)
Operating Conditions: 2540 psig, 1050 F
Insulation: 6 in. total thickness
Expansion: 70 F to 1050 F is 9.47 in. per 100 ft

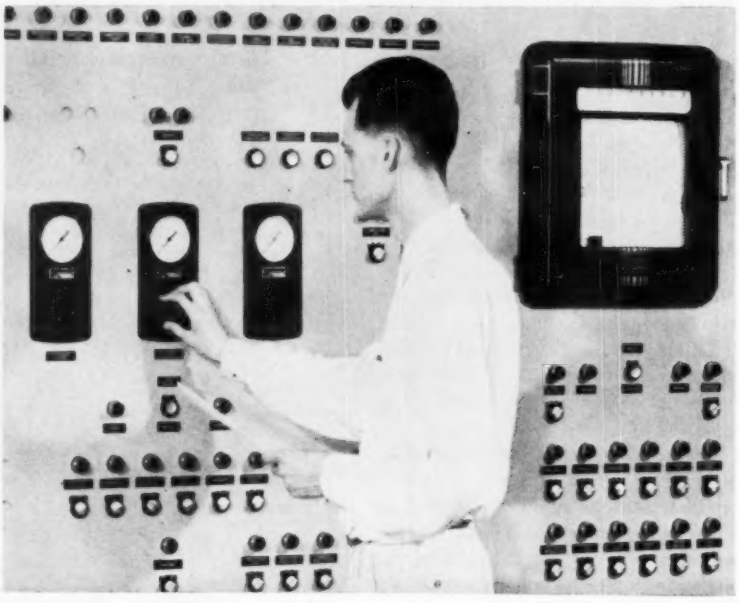
Sample readout of results

Member	FX	FY	FZ	MX	MY	MZ	DX
0	–46	–991	–1408	–187596	–36749	–64898	–0.968
1	–46	–991	–1408	–100266	–36749	–67794	–0.971
2	–46	–991	–1408	47411	30658	–120143	–1.375
3	–46	–991	–1408	117813	127349	–190545	–1.937
4	–46	–991	–1408	166893	153916	–210874	–2.091
5	–46	–991	–1408	409337	142497	–210874	–1.946
6	–46	–991	–1408	478747	40629	–141464	–1.320
7	–46	–991	–1408	478747	–69236	–64122	–0.704
Restraint	–0	–0	0	–0	–0	0	–0.704

By C T DICKERT, R HETHERINGTON
and C F RAINES, Rohm & Haas Co



ATOMIC PLANT, Shippingport, Pa. has...



AUTOMATIC CONTROLS for coolant treatment in the pressurized-water reactor

Radioactive water poses new problems

Today, 24 power reactor projects are running or scheduled. So it's important to know how water impurities cut efficiency, complicate maintenance. Part 1 of a 2-part report explains cause of these troubles. Part II tells how to cope with them

Operating conditions in the primary-coolant system of a power reactor appear to resemble a conventional steam boiler. In both cases, temperature is in the 400- to 600-F range, with some parts of the system operating at about 200 F. Pressures range from 1000 to 2500 psi. Although high-pressure boilers call for high-quality water, companion standards for reactor systems are extraordinarily high by comparison. And they must be met in spite of a variety of adverse chemical reactions, like those shown in Fig. 1. These stringent water limits, coupled with radioactivity in the water loop, call for new approaches to water treatment.

Pressurized-water reactors, perhaps furthest along in commercial development, use primary water as both a moderator and coolant. It circulates through the reactor, picks up heat from the core, and transfers it to secondary water through heat exchangers. These special boilers generate the steam for conventional use in turbine - generators. Enormous volume of water needed for cooling plus the fact that water becomes radioactive passing through the reactor calls for a closed - loop primary cooling system. Basic problem is keeping water quality up to par even though impurities are continually forming within the primary loop.

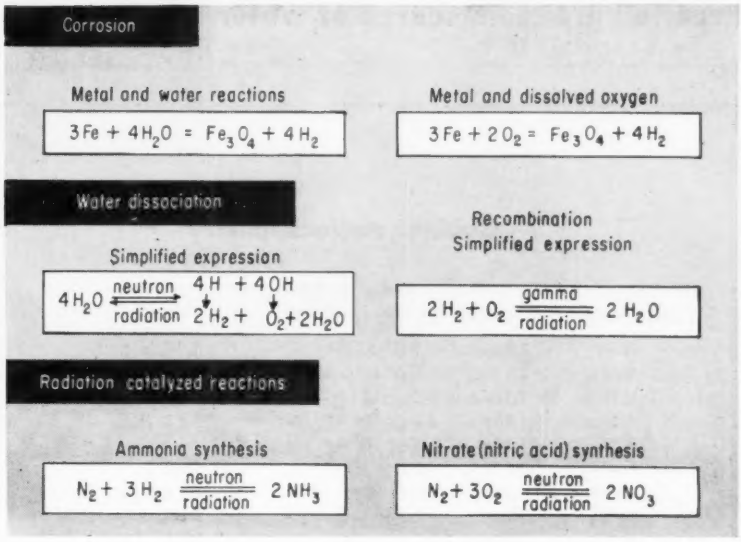
Water treatment goals are (1) removing the maximum amount of dissolved and suspended solids and dissolved gases and (2) keeping water noncorrosive to limit formation of more impurities in the system.

Water quality

Primary-loop water quality is acceptable if in the range of 1 to 2 ppm total solids. About 10% or 0.2 ppm can be in solution. System resistivity will then be about 2 million ohm-cm. Table 2 shows data collected during operation of the APPR reactor at Fort Belvoir, Va.

Most materials become radioactive quickly when exposed to the intense flux in the reactor core. So low solids concentration is critically important as a way of keeping radioactive pick-

1—Chemical reactions in primary-water loop


Corrosion
Metal and water reactions
3Fe + 4H2O = Fe3O4 + 4H2
Metal and dissolved oxygen
3Fe + 2O2 = Fe3O4 + 4H2
Water dissociation
Simplified expression
4H2O neutron radiation 4H + 4OH
2H2 + O2 + 2H2O
Recombination
Simplified expression
2H2 + O2 gamma radiation 2H2O
Radiation catalyzed reactions
Ammonia synthesis
N2 + 3H2 neutron radiation 2NH3
Nitrate (nitric acid) synthesis
N2 + 3O2 neutron radiation 2NO3

2—Analysis of primary water in the APPR*

Components	Normal levels
Chlorides	0 to 1.0 ppm
Iron	0 to 1.0 ppm
Cobalt	0 to 0.1 ppm
Nickel	0 to 0.5 ppm
Manganese	0 to 0.5 ppm
Chromium	0 to 0.5 ppm
Total solids	1 to 2 ppm
Oxygen	0 to 1.0 cc/liter
Hydrogen	0 to 30 cc/liter
Ammonia	0 to .5 ppm
Total dissolved solids	1 to 2 ppm
pH	6.4 to 9.0
Resistivity	0.6 to 2.5 × 10^6 ohm-cm

*Summary of overall loop conditions during 700 hours of continuous operation from *Coolant Technology at the Army Package Power Reactor*, by A Louis Medin, 18th Annual Water Conference, Pittsburgh, Pa.

up to a minimum. Dissolved gases are a parallel problem since many not only become radioactive (oxygen-16 to nitrogen-16 and argon-40 to argon-41), but also play a major role in corrosion reactions that add solids to the system. Some act as poisons.

Maintenance

Radioactivity within the primary circuit complicates routine or emergency maintenance of equipment and calls for stringent safety precautions. Any leakage into unshielded areas, for example the secondary water circuit, raises very serious contamination problems for personnel and equipment. Solids also are undesirable because they cut reactor efficiency. In the process of irradiation they absorb neutrons that are otherwise available to sustain the fission reaction. Radioactive nuclides in the primary system of a pressurized-water reactor are listed in Table 3. Nature of the activity will vary with each installation. Nuclides that are hard gamma emitters produce a high gamma field around the coolant system. Soft gamma or pure beta emitters are hazardous to personnel when the system is shut down and opened.

Since the primary system is a closed loop and very little makeup is added during reactor operation, the main source of solids are the loop materials of construction. Some of these solids are produced by the reaction between system metals and high-purity water, which is quite aggressive at loop operating temperatures. Rate of reaction is increased by oxygen and low pH (from radiation-catalyzed synthesis of nitric acid during operation of the reactor).

Oxygen is the key to much of the corrosion problem. Entrained air in piping is one source. Another is air dissolved in makeup water used to fill the system. It attacks most alloying elements in stainless-steel structures and system components. Table 4 lists types of insoluble corrosion products (crud) and their relative concentrations in a primary system constructed of type-347 stainless steel. Aggregate crud is usually less than 1 ppm.

Dissociation

Dissociation of water by fast neutrons during reactor operation also produces oxygen. But gamma radiation from decaying nuclides accelerates recombination of oxygen and hydrogen into water. Since relatively few nuclides are present during startup, free oxygen is more likely to be present, and chances of corrosion is greatest during initial operation.

Some corrosion products go into solution or suspension, while those remaining form deposits or scale on system equipment. They're unwelcome in any form because of their susceptibility to radiation. Short-lived activities in the primary system decay to negligible levels a few minutes after reactor shutdown. But long-lived species that remain in water or deposit on piping and vessel walls can make the reactor compartment inaccessible. In one operating loop, activity level of primary water 15 minutes after shutdown ranged between 0.05 and 0.1 microcurie per ml water. But radiation around piping ranged between 2 and 200 milliroentgens per hour depending on the point of measurement.

Inhibiting corrosion

Corrosion is actually inhibited by the hydrogen evolved from the metal

System materials of construction are main source of water impurities

water reaction. Hydrogen and oxygen are synthesized to water. This takes available oxygen away from possible reaction with metals or synthesis into nitric acid.

Hydrogen and nitrogen are synthesized into ammonia by radiation. This helps keep an alkaline pH in the system. Generally, gaseous hydrogen is added to provide the excess hydrogen needed to promote these favorable reactions.

Reactor controls

Mechanical and thermal operation of reactors may be affected by corrosion deposits in the system. These interfere with close tolerance mechanisms such as throttling valves and control-rod drives. Experience with the pressurized-water reactor at Chalk River shows that deposits of corrosion products from stainless steel seriously affect heat transfer. And oxide coatings on clad fuel elements increase surface temperatures and up the rate of corrosion.

Certain anions in the water are objectionable for reasons other than radioactivity. Low chloride concentrations in primary water are dictated by the strong circumstantial evidence that chlorides, in the presence of oxygen, cause stress corrosion in austenitic steel. This is mainly a precautionary measure since stress corrosion is far less common in primary than in secondary systems.

Argon and xenon

Argon and xenon are also troublesome. Argon is irradiated to argon-41 in the loop. Xenon-135, produced by fission product decay, has a large cross section for neutron capture. This reduces the multiplication factor sustaining the chain reaction in the reactor. Both gases can be introduced from any air dissolved in the makeup water when the system is filled.

Second part of this report will explain how today's water-treatment equipment, chemicals and controls are used to tame radioactive water—in an upcoming issue.

3—Coolant radiochemistry

Element	Half-life	Radiation level, microcuries/ml	Source
N 16	7.3 sec	100	0 16 in H_2O.
N 17	4.1 sec	(800 neutrons/cm^3/sec)	0 17 in H_2O.
K 38	7.7 min	5×10^{-2}	
A 41	1.8 hr	4×10^{-2}	Air in H_2O.
F 18	1.9 hr	4×10^{-2}	
Mn 56	2.6 hr	0.5×10^{-2}	Steel
Na 24	15 hr	1×10^{-3}	Na in H_2O.
Co 60	5.3 yr	2.5×10^{-5}	Steel
Fe 59	45 days	1.1×10^{-5}	Steel
Ta 182	111 days	0.6×10^{-5}	Steel

Taken from *Water Technology for Primary Systems in Water Cooled Power Reactors*, by D M Wroughton, J M Seamon and H F Beeghly, unpublished, Westinghouse Electric Corporation

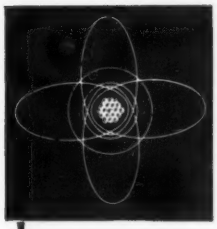
4—Analysis of system crud

Material	Theoretical chemical analysis†		
	Iron	*Chromium*	*Nickel*
Stainless steel	1.00	0.230 to 0.275	0.122 to 0.174
AISI type 347	1.00	0.40 to 0.143	0.143 to 0.157

†Spread in five crud samples taken at various times

Assumed oxide form	Spectrographic analysis
Fe_3O	93.0
Cr_2O_3	0.42
NiO	5.6
MnO	0.23
CoO	0.43
Nb_2O_5	0.01
CuO	0.03
SiO_2	0.06
Al_2O_3	0.10
MgO	0.10

Compiled by B G Schultz, Westinghouse Electric Corporation, cited in *Corrosion and Wear Handbook*, U.S. Atomic Energy Comm.



Nuclear notes

By B G A SKROTZKI, Associate Editor

Brisk bidding responded to AEC invitation for operation of Argonne Low-Power Reactor (ALPR) at the National Reactor Testing Station in Idaho. The plant starts this summer, consists of a boiling-water reactor producing 200 kwe and 1.3-million Btu per hr space heating. It was planned for remote military installations. Winning bidder gets a cost-plus-fixed-fee contract to run through June 1960. Bidders included: AEC Industries, Inc; Aerojet-General Corp; Alco Products, Inc; Atomics International; Bendix Aviation Corp; Combustion Engineering, Inc; Internuclear Co; the Martin Co; Nuclear Development Corp of America; Phillips Petroleum Co; Westinghouse Electric Corp; AMF Atomics Division of American Machine and Foundry Co; American Standard, Atomic Energy Division.

Waste-disposal licensees will increase from four to five when American Mail Line Limited is approved by AEC. Under proposed license AMLL receives packaged wastes, such as radioisotopes and radioactive uranium and thorium, from Boeing Airplane Co. It stores them aboard ship away from living quarters and dumps them in the Pacific Ocean at least 150 miles off the continental shelf in more than 1000-fathom depth during one of its regular commercial runs. The line will not get more than 10 curies of byproduct material or 15 lb of source material at one time.

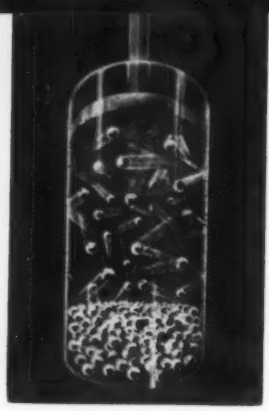
Experimental Breeder Reactor II (EBR-II) building, at AEC Station in Idaho Falls, will go critical in 1960. The reactor will be unmoderated and use primary and secondary sodium-cooling systems to produce 1250-psig 850-F steam. The 62.5-mwt rating will develop 20 mwe. The plant will include fuel reprocessing and refabrication sections to remove plutonium and uranium from the enriched-uranium core and depleted-uranium blanket.

Nuclear-plant components for sodium coolant will be designed and analyzed by three firms under new series of contracts awarded by AEC. These studies will initiate a drive to develop less expensive and more reliable major non-nuclear components to operate with liquid sodium at high temperatures. Contracts for heat exchangers and steam generators went to Griscom-Russell Co, Alco Products, Inc and Combustion Engineering Co, Inc.

Light-water cooled and moderated reactor to produce 60 mwt for the National Advisory Committee on Aeronautics was licensed by AEC. Reactor, to be built at Plum Brook Ordinance Works near Sandusky, Ohio, will be used to research and develop reactors for aircraft. The unit will cost $10.7 million and start about Jan 1960. It will be held in a vertical stainless-steel-clad pressure tank 9 ft in dia and 32 ft high. The AEC has allocated a net 224 kilograms of U-235 to the reactor through 1970.

Closed-cycle boiling reactor at Elk River, Minn., gets going again with the contract signed between AEC and Nuclear Products-Erco Div of ACF Industries, Inc. The 22-mwe plant will have fuel-fired superheater and use a mixture of thorium and uranium oxides in reactor core. Total cost to AEC will be about $11.5 million.

New publication, "Growth Survey of the Atomic Industry, 1958-1968" published by the Atomic Industrial Forum, Inc, 3 East 54th Street, New York 22, N. Y., gives the latest look at market potentials for manufacturers in this field. The 84-page report includes over 50 charts and tables, costs $25.00.



THERMO REFRESHER NO. 21

By B G A SKROTZKI, Associate Editor

Searching for a lightweight i-c engine led to substituting an air cylinder for a flywheel and doing air compression in two stages. These ideas jelled into a heat engine that produces hot pressurized gas to run a gas turbine, it's . . .

The free-piston gas generator

One of the newest heat engines is the free-piston gas generator supplying a gas turbine. The generator, Fig. 1, has undergone a long period of development since about 1922. Its principal advantage lies in its light weight and good thermal efficiency. While it is a reciprocating engine it needs no crankshaft or flywheel. There are about 350 gas generators operating or under construction for both stationary and transportation applications.

Operation. Fig. 1 shows the processes and principal parts of a free-piston gas generator. Two piston assemblies move in opposite directions centered on a common *diesel-engine cylinder.*

Expanding gas in the engine cylinder pushes the piston assemblies outward. This makes the outer faces of the large pistons compress air trapped in the outer *bounce cylinders.* The rising bounce-air pressure decelerates the piston assemblies and brings them to a stop.

The expanding bounce air then pushes the piston assemblies towards each other. This compresses air trapped in the engine cylinder which again decelerates the pistons and brings them to a stop in the inner position. Fuel injected into the engine cylinder then burns and this energy helps to push the pistons apart during the next cycle.

The inner faces of the large pistons work in a pair of air-compressor cylinders that take air from the atmosphere as working fluid for the cycle. Let's trace the processes of the working fluid in Fig. 1 with the aid of the graphs of Fig. 2, top of page 94.

Cylinder actions. In the outer positions, atmospheric air fills the compressor cylinders. During the inward stroke, under the influence of the expanding bounce air, the air compresses to an intermediate pressure and then discharges to the air receiver surrounding the engine cylinder. During the next outward stroke, the air remains in the receiver at this pressure; but towards the end of the stroke air-inlet ports in the engine cylinder uncover to admit pressurized air into the cylinder. This *scavenges* or pushes the remaining combustion gases out of the cylinder into the gas outlet of the cylinder.

Ideally, we assume the fresh air charge just displaces the spent gas scavenged from the cylinder. (Actually, some of the scavenge air passes out with the combustion gas and flows on to the turbine.) During the following inward stroke, the pistons cover the gas-outlet and air-inlet ports, trapping the air charge and compressing it in the engine cylinder.

At the end of the stroke, fuel injected into the cylinder burns to keep engine pressure constant during the early part of the next outward stroke. The burned gases then expand while doing work on the pistons. As the pistons move outward, the gas-outlet ports are first uncovered and the gases throttle to a lower pressure, usually equal to the air-receiver pressure. By the time the gas throttles to the outlet pressure, the air-inlet ports uncover to admit pressurized air that pushes the remaining gas out of the cylinder.

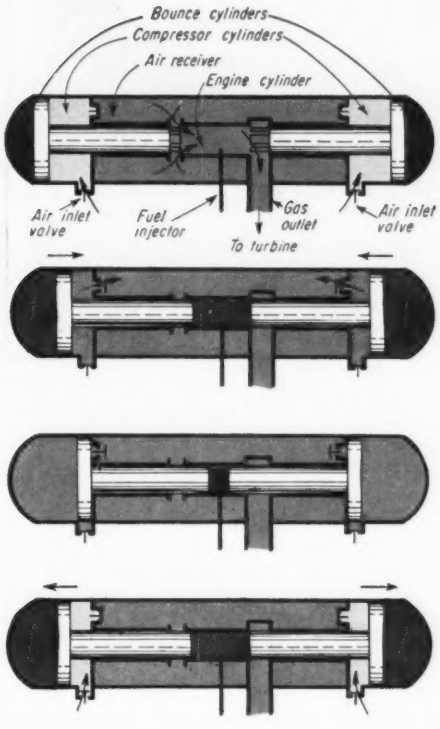
Processes. Fig. 2 shows the processes and work and heat transfers in a gas generator. On the *PV* graph, *1-2* is the constant-*S* compression process in the air compressors; the gray area to the left of the curve measures total compressor work, W_c. Line *b-1* represents atmospheric air entering the compressor cylinder as on an indicator card. Area under the line measures the work done on the piston by the entering air. Line *2-a* shows the pressurized air discharging from the compressors into the receiver. We assume zero compressor clearance. The receiver air is at state *2*.

Process *2-3* compresses the air in the engine cylinder at constant-*S;* *3-4* is the constant-*P* heat addition Q_a to the cycle by the burning fuel. From *4* to *5* the gases expand at constant-*S* as they work on the engine piston faces. Process *5-2* shows the pressure drop of the gases as they throttle out of the cylinder through the gas-outlet ports. This variable-flow throttling (an irreversible process) ends up with the gas in an average state *6* at the pressure of the receiver air.

In an equivalent ideal cycle, we assume that *5-2* represents a constant-*V* cooling of the working fluid in the engine cylinder. The energy removed during this cooling transfers irreversibly to heat an equal amount of air initially in state *2* at constant-*P* to the final state *6*.

Net cycle output. The free-piston generator takes air at state *1*

Free-piston gas generators work with high-efficiency gas turbines



Piston position	Compressor action State	Compressor action Process	Engine action State	Engine action Process	Bounce-cylinder pressure	Work transfer	Heat or energy transfer
Outer	1	End air intake	5 to 2 2	Scavenging: Gas exhaust to turbine. Air intake from receiver	Maximum	None	Engine exhaust to gas turbine
Out to in	1 to 2	Compression and air discharge to receiver	2 to 3	Compression	Intermediate	Bounce piston to compressor and engine pistons	None
Inner	a to b	End air discharge to receiver. Start air intake	3	Fuel injection and ignition	Minimum	None	Fuel heating energy to engine air
In to out	b to 1	Air intake	3 to 4 4 to 5	Combustion Expansion	Intermediate	Engine and compressor pistons to bounce pistons	Combustion in engine cylinder

1 Free-piston gas generator takes atmospheric air into compressor cylinders for pressurizing, then delivers it to engine cylinder through air receiver. Fuel burned in engine supplies compressor work; gas exhausting from engine is hot and pressurized

and energizes it to state *6*. The unit does not produce any mechanical work output. To get this work we must pass the gas flow through a gas turbine. Even though the gas discharges in pulses, the usual operating rate of 1000 cycles per minute for these free-piston units gives an effective steady flow. Since we haven't studied steady-flow processes, let's assume the air does work in an ideal complete-expansion air engine, see Part 16, POWER, Feb 1958, p 97. This will give the same result.

In Fig. 2 we assume the gas enters the engine during *a-6*; it then expands at constant-*S* to state *7* where its pressure has dropped to atmospheric. The spent gas exhausts to atmosphere during *7-b*. Total hatched area *a-6-7-b* measures the work output of the engine which is also the cycle net work output, W_t.

Work and heat transfers. Between the air and gases in the generator there is considerable transfer of mechanical work, but the unit produces no net work. Let's take a close look at what happens.

All the gross engine work produced during the working stroke *3-4-5* is stored as internal energy in the bounce air. Air entering the compressor cylinders during this stroke also contributes a small amount of energy to the bounce air, this is measured by area under *b-1*.

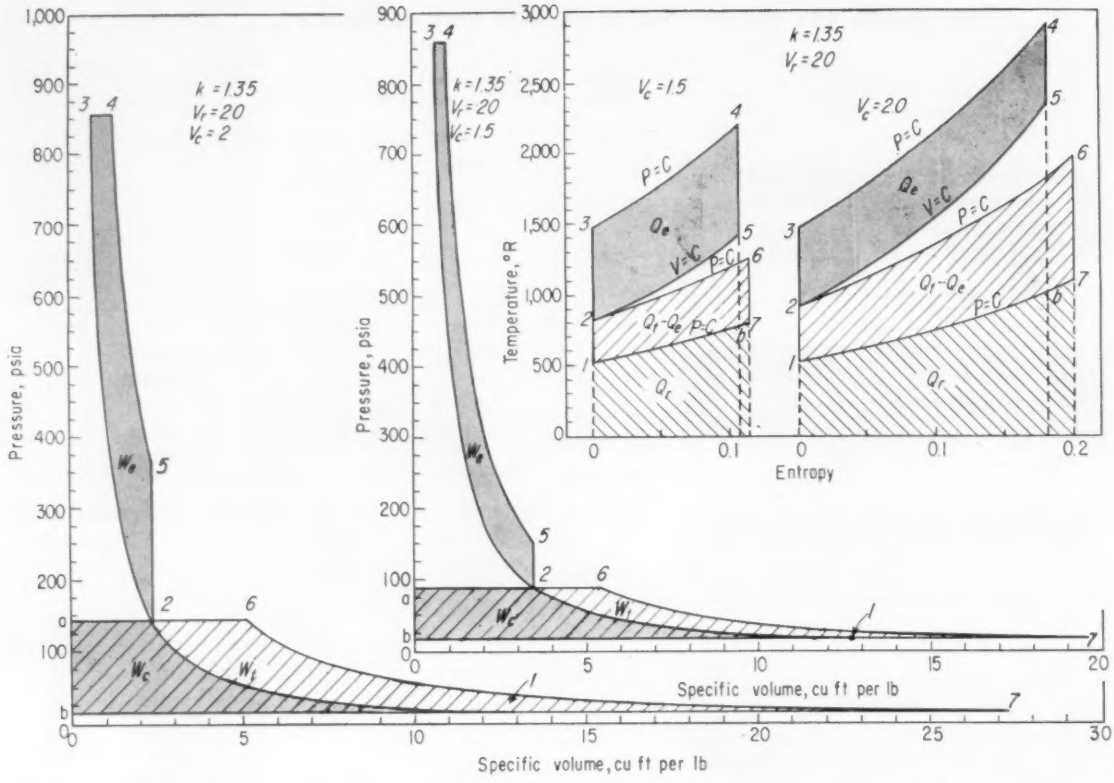
When the bounce air expands on the following stroke it does work in compressing the entering air and the air charge in the engine cylinder. Since no net work leaves the gas generator and no net work is stored in the bounce cylinders, the net work done by the free-piston engine must equal the net work absorbed by the compressors, $W_e = W_c$.

This means, on the *PV* graphs of Fig. 2, that area *2-3-4-5* equals area *a-2-1-b*, the net work transfer between engine and compressor cylinders. On the *TS* graphs, we find constant-*S* processes *1-2* and *2-3* in the air compressor and engine cylinders. Heat Q_a is added to the cycle during *3-4* at constant-*P*. Total area under *3-4* measures Q_a.

From *4* to *5* the engine gas expands at constant-*S*. From *5-2* the engine working fluid cools at constant-*V*. Then, area *2-3-4-5* measures the net heat used by the engine cylinder Q_e. By the first law we see $Q_e = W_e$; but remember that $W_e = W_c$, too.

We have assumed that the heat rejected by the engine heats air at constant-*P*, then the total area under *2-5* equals the area under *2-6*, that is, $c_v(T_5 - T_2) = c_p(T_6 - T_2)$. This assumption enables us to calculate state *6*, note increase in entropy.

The air expands at constant-*S* from *6* to *7* in the air engine. Assuming an equivalent closed cycle, the air cools at constant-*P* from *7* to *1* while it rejects unusable heat Q_r from the cycle. Since all the processes we assumed are internally reversible, the



2 *PV* and *TS* graphs are for free-piston gas generator with overall compression ratio of 20 and at fuel cutoff ratios of 1.5 and 2.0. This air-standard analysis shows that air-receiver pressure at *a* rises with increasing output measured by area *a-6-7-b*

1—Free-piston gas-generator power cycle has same efficiency as diesel cycle

1. $e = 1 - (Q_r/Q_a) = 1 - \dfrac{c_p(T_7 - T_1)}{c_p(T_4 - T_3)}$ (see Fig. 2)
2. $c_p(T_6 - T_2) = c_v(T_5 - T_2)$
3. $T_6 = \dfrac{T_5 + T_2(k-1)}{k}$
4. $\dfrac{P_1}{P_2} = \left(\dfrac{V_2}{V_1}\right)^k = \left(\dfrac{V_6}{V_7}\right)^k = \left(\dfrac{1}{V_{rc}}\right)^k$

V_{rc} = compressor compression ratio

5. $T_2 = T_1\left(\dfrac{V_1}{V_2}\right)^{k-1} = T_1 {V_{rc}}^{k-1}$
6. $T_3 = T_1\left(\dfrac{V_1}{V_3}\right)^{k-1} = T_1 {V_r}^{k-1}$
7. $T_4 = T_3\left(\dfrac{V_4}{V_3}\right) = T_3 V_c = T_1 V_c {V_r}^{k-1}$
8. $\dfrac{V_3}{V_2} = \dfrac{V_3}{V_1} \times \dfrac{V_1}{V_2} = \dfrac{V_{rc}}{V_r}$
9. $T_5 = T_4\left(\dfrac{V_4}{V_5}\right)^{k-1} = T_1 V_c {V_r}^{k-1}\left(\dfrac{V_c V_3}{V_2}\right)^{k-1}$
$= T_1 {V_c}^k {V_{rc}}^{k-1}$
10. $T_7 = T_6\left(\dfrac{V_6}{V_7}\right)^{k-1} = \dfrac{T_5 + T_2(k-1)}{k}\left(\dfrac{1}{V_{rc}}\right)^{k-1}$
$= \dfrac{T_1 {V_c}^k {V_{rc}}^{k-1} + T_1 {V_{rc}}^{k-1}(k-1)}{k}\left(\dfrac{1}{V_{rc}}\right)^{k-1}$
$= T_1({V_c}^k + k - 1)/k$

Substituting in (1) and after cancelling T_1's

11. $e = 1 - \dfrac{({V_c}^k + k - 1)/k - 1}{{V_r}^{k-1}(V_c - 1)}$
$= 1 - \dfrac{1}{{V_r}^{k-1}}\left[\dfrac{{V_c}^k - 1}{k(V_c - 1)}\right]$

Compare with diesel-cycle thermal efficiency
POWER, July 1958, Part 20, p 95

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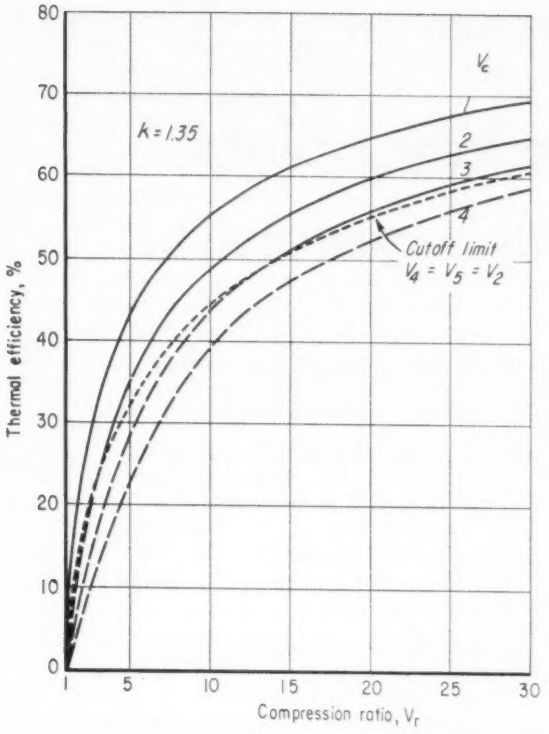
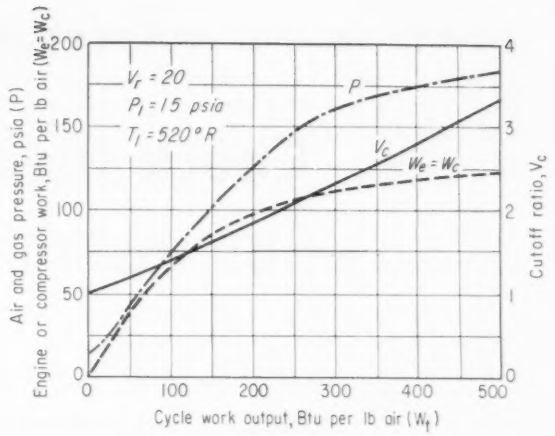
net heat Q_t converted to work W_t must be: $Q_t = Q_a - Q_r$. Since the last two heat areas are not coincident, because of irreversible heat transfer from *5* to *6*, we have no single area to show Q_t on the graph.

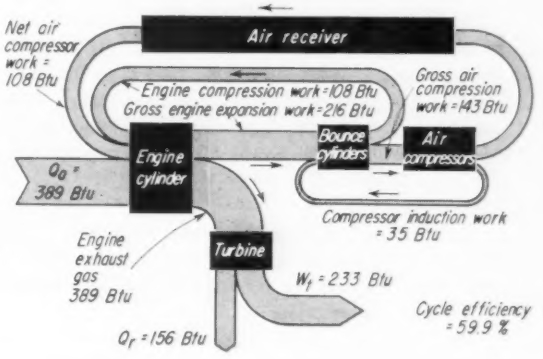
But note on the *PV* graph that area *1-2-6-7* represents the difference of W_t and W_c and furthermore $W_c = Q_e$. Then, on the *TS* graph, this area must represent $Q_t - Q_e$. The total net cycle work output then equals the sum of the two areas *2-3-4-5* and *1-2-6-7* or $Q_e + (Q_t - Q_e) = Q_t$; remembering that $Q_e = Q_c$. But Q_e can't be shown on the *TS* graph because no heat transfer is involved in air-compressor processes.



3 Thermal efficiency of the free-piston cycle is the same as the diesel cycle except that cutoff ratio is much more limited


Air and gas pressure, psia (P)
Engine or compressor work, Btu per lb air ($W_e = W_c$)
Cutoff ratio, V_c
Cycle work output, Btu per lb air (W_f)
$V_r = 20$
$P_1 = 15$ psia
$T_1 = 520°R$
P
V_c
$W_e = W_c$

5 Air-receiver and exhaust-gas pressures rise with increasing cycle output as well as with cutoff ratio and compressor work


Net air compressor work = 108 Btu
Air receiver
Engine compression work = 108 Btu
Gross engine expansion work = 216 Btu
Gross air compression work = 143 Btu
Engine cylinder
Bounce cylinders
Air compressors
Q_0 = 389 Btu
Compressor induction work = 35 Btu
Engine exhaust gas 389 Btu
Turbine
W_f = 233 Btu
Cycle efficiency = 59.9 %
Q_r = 156 Btu

4 Energy-flow diagram for free-piston cycle shows that mechanical work circulates internally in the unit between elements

Variable output. Graphs in Fig. 2 drawn for two different work outputs show that the air-receiver pressure varies. The center *PV* and *TS* graphs are drawn for overall compression ratio of compressors and engine of $V_1/V_3 = V_r = 20$ and a cutoff ratio of $V_4/V_3 = V_c = 1.5$. At this output the air-receiver pressure is about 87 psia, and maximum gas temperature in the engine is about 2200 °R.

For the higher output developed at cutoff ratio of 2.0 shown in the outer *PV* and *TS* graphs of Fig. 2, the air-receiver pressure rises to 143 psia, and maximum gas temperature rises to 2960 °R. Fig. 5 shows how receiver pressure, engine and compressor works, and cutoff ratio vary with output.

When we assume constant-pressure heat addition to the cycle, we find that the theoretical thermal efficiency is the same as for the diesel cycle, as shown in Table 1. Fig. 3 shows how thermal efficiency varies with compression and cutoff ratios when $k = 1.35$. The cutoff has a much lower upper limit than in a diesel engine, see Part 20, POWER, July 1958, p 94. This follows from the 2-stage compression used and the much smaller expansion ratio in the free-piston engine cylinder.

Energy flow can be shown as in Fig. 4 for an ideal free-piston gas-generator turbine cycle. For the ideal condition, all the energy input to the engine cylinder (cycle) appears in the exhaust gas. A constant amount of energy circulates in all other parts of the gas generator, apparently not contributing to cycle work output. To make the cycle run, however, this energy circulating between the engine, bounce cylinders, air compressors and air receiver is essential.

The bounce cylinders perform the same duty as a flywheel in the otto and diesel engines. They store some of the gross engine work intermittently to compress the engine air before firing. In the free-piston gas generator this compression is done in two stages: first, in the air compressors and, finally, in the engine cylinder.

Many papers have been written on estimating the performance of actual free-piston gas generators. We believe that this article is the first study published on setting up an air standard for the ideal free-piston unit comparable with that used for many years for the otto and diesel cycles.

Next part will study actual engine performance and start on steady flow thermodynamics, in November issue.

HOW TO ORGANIZE YOUR NEW POWER PLANT — 34

Check these key points when installing a generator

Here's how to dry out a generator, get it ready for initial operation, check phase rotation, and find out whether it can be synchronized with the rest of your electrical system

By DONALD SWIFT, Ebasco Services Incorporated

Following up on article No. 33 in this series ("What you need to know about the generator—heart of your power plant," POWER, May 1958, pp 92-93,) we now consider in detail the problems of erecting and starting a new generator.

Generator erection. Generators are often shipped as complete assemblies, unless they are too large. In any case, they should be kept as dry and clean as possible during erection.

The generator field and armature insulation are dried out at the factory, and show a high resistance value to a megohmmeter test. But, if units stand in cold damp buildings or out in the open for some weeks, they may absorb enough moisture to cause a serious drop in megohmmeter readings.

Effective ways to keep insulation dry include (1) sealing generator housing during shipment and erection (2) using silica gel to absorb moisture (3) using electric space heaters or other heat sources to keep the machine warm until it is ready to run.

Generator dryout. If generator is damp, insulation values may be down to one-half to one-quarter those obtained at the factory, and unit should be dried out. Moisture is probably driven out most effectively by heat from inside the coils. The usual procedure is to short-circuit the generator terminals or bus bars and operate at one-half to three-quarter speed with a light field current. Use the generator ammeter or provide a temporary ammeter to check stator curent when applying this field. Gradually bring temperatures up to 70 to 80 C, and take megohmmeter readings to check trend of insulation resistance readings.

An 18-C increase in winding temperatures approximately halves the insulation resistance reading. The readings often rise, then drop, and rise again as "layers" of moisture are driven out. Continue drying for 48 to 72 hours, until reading has been steady for 8 or 12 hours, assuming that insulation resistance value reaches a level high enough for safe operation.

Shut unit down while taking each megohmmeter reading and correct for temperature. A formula for minimum safe stator insulation value in megohms at about 75 C is stated as follows:

[Rated voltage of machine]/[(0.01 $\times$ rated kva) + 1000]. Rotor insulation value at 25 C should be at least 10 megohms.

If the weather is warm and dry or if the building is well dried out and warm, the dryout run may be made with generator open to the atmosphere. Otherwise, fill unit either with air that has been passed through a silica-gel drier, or with carbon dioxide. The intent is to provide a reservoir of dry gas that can absorb the insulation moisture. If windings are noticeably damp, you may have to purge the generator continuously with dry gas or air.

High potential test. To assure that generator windings have not been damaged during shipment or erection, give windings a high potential test after they are dried out and generator is completely assembled. If you do not have the necessary regulators, transformers and sphere gaps, you can usually rent them from the generator manufacturer or a nearby utility.

Factory tests of this type are made at twice rated voltage plus 1000 volts. Field tests on new equipment may be made at 75% of this value.

When test equipment has been connected and the sphere gaps set to arc at not more than 20% over

test voltage, apply up to 50% of final test voltage. Then, gradually increase to the test voltage within one minute and hold at this value for one minute. Next, reduce to the 50% value in about one minute before disconnecting the test set. Observe the charging current throughout the test.

Apply this test to all three phases connected together, then to each phase individually with the other two phases grounded.

The high potential tests are considered satisfactory when (1) the charging current is substantially constant during the test and (2) neither the insulation nor the sphere gap breaks down.

After the test, ground the equipment long enough allowing it to be released for any other work.

Preparing for startup. After removing the short-circuit bars, close the generator and prepare for regular operation. Check these points: (1) Is hydrogen system ready for service? (2) Are generator bus connections tight, insulators cleaned and checked? (3) Are potential and current transformers and instruments checked in place, clear and properly wired? (4) Have oil circuit breakers and transformers been serviced and operated on a trial basis? (5) Is field circuit breaker in good working condition, adjusted and tried out? (6) Are field collector rings clean; brushes well-fitted? (7) Is exciter in good condition with clean commutator and all brushes in place under proper spring pressure? (8) Has field rheostat been tried out for proper operation? (9) Are voltage-regulator wiring connections complete and checked? (10) Has generator field been preheated if required by manufacturer's operating instructions? (This should be done at less than rated generator speed.)

Checking phase rotation. If the new generator is to be connected to a system already in operation, its phase rotation must conform. Generator terminals may be marked to show *A*, *B* and *C* phases, or generator prints may give data necessary to determine it. In any case, rotation must be checked.

If you attempt to synchronize two units when phase rotation is not matched, two phases are essentially short-circuited, even though the third phase voltages are equal and in phase.

Use a phase rotation meter or a small 3-phase motor for checking. Connect potential transformers to the bus between generator circuit breaker and outer set of disconnects. Connect motor or phase rotation meter to the potential transformers. With the generator running at about synchronous speed, close the disconnects with the oil circuit breaker open. Note direction the motor or meter turns. Then open the disconnects and close the circuit breaker and again note direction of rotation of the motor or meter.

If rotation is the same both times, generator phase rotation is the same as the system. If rotation is opposite, connections from two phases of the generator or system must be interchanged, and the above check must be repeated.

Though less desirable, in some cases you can isolate an auxiliary bus and feed it first from the system and then from the new generator. Check rotation of some motor on this bus when it is connected to each source. But make sure that no equipment would be damaged if phase rotation were reversed and motors ran backward during the test.

Also check auxiliary power phasing and phase rotation. This must be done before the unit auxiliary power transformer, which is usually connected directly to the generator leads, can be cut into service safely. If it is not done, all auxiliaries may be reversed, or you may get the effect of an out-of-phase connection when this transformer is paralleled with a transformer that is already on the line.

Checking synchroscope. Potential transformers temporarily installed for checking phase rotation may also be used to check the synchroscope and other devices that indicate when system and generator are running in synchronism.

Connect the three potential transformers across the oil circuit breaker terminals of each phase. Then, with the unit at or near synchronous speed, oil circuit breaker open and outside disconnects closed, you get an indication of voltage across the generator breaker. All lights should fade on and off together, and you can check synchroscope rotation by varying generator speed above and below system speed.

Work carefully, with due regard to the voltages being handled. A mistake here may result in personal injury or damage to the generator.

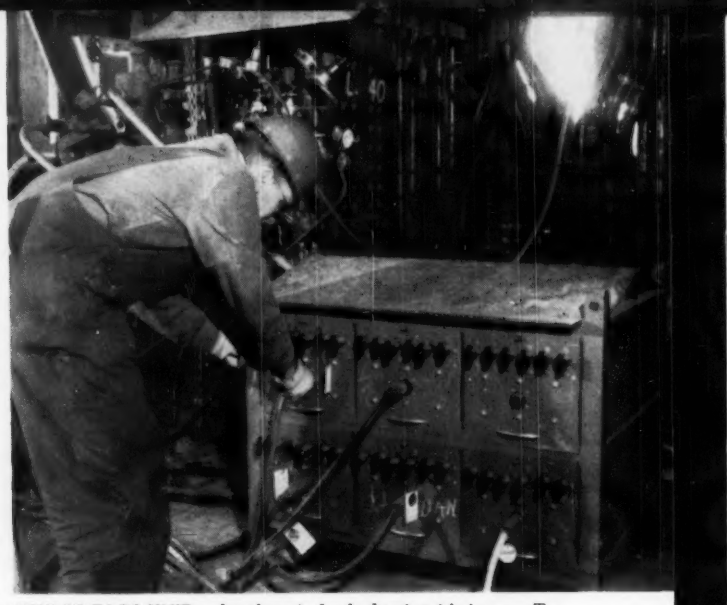
Operation on the line. The new unit may be brought up to speed, synchronized and put on the line when (1) all reasonable steps have been taken to assure that it may be safely connected to the system and (2) the steam end of the station is ready to carry load. Load is usually limited to 5 or 10% of rating for a time to see how the equipment behaves. You may need to refine the turbine-generator balance.

Ordinarily, use air in the generator system during initial operation. This avoids wasting gas and time if balance weights have to be added. At 3600 rpm, 3-mils vibration on generator shaft is passable and 1 mil or less is good. Lower speeds permit operation at considerably higher vibration amplitude.

Loading the generator. A hydrogen-cooled generator running in air can carry about half-rated capacity without overheating. Gradually increase load to that level to check the balance under load with a hot rotor. You may need several days to get all elements of the new plant working properly up to this level.

Complete any balancing before filling cooling system with hydrogen. Inspect generator and turbine bearings at this time to be sure they are clean and in good condition (*Continued on page* 159)

BY S B PALMETER, and E J BACHMAN
Burns and Roe, Inc



WELDOR TAGS UNIT as he plugs in lead, showing it's in use. To shift location, he simply unplugs, untags and moves to new area

Trend toward in-plant distribution favors ac. Now, 80-v dc for welding supply during construction is proving out at Jersey Central's Sayreville job to the tune of $87,500 savings

Dc distribution cuts welding costs

A single dc power source for 104 welding operators is saving Jersey Central Power and Light Co more than $5000 per month during construction of their Sayreville Station extension.

Three phase, 4160-v power steps down to 460-v, then feeds three silicon rectifiers. Single-pole disconnect switches connect the rectifier output to main welding bus. Two 1500-mcm risers at either side of the boiler are tapped at four elevations. Cables lead off from these tap points to 6-bank welding stations. Here, the operator adjusts amperage from 10 to 295 in 5-amp steps.

Rectifiers were chosen for their economy. Placing rectifiers outside the plant eliminated costly 460-v conduit distribution. Maximum open-circuit voltage indoors is 80-v dc. Small rheostats replaced individual power packs for each arc, lowering initial equipment cost.

Big savings, though, come in reduction of man-hours needed to do job. Operators save an estimated thirty minutes a day since they can adjust welding heats near their work. Placement of resistor banks in the building puts almost every point within one cable length (75 ft) of any one bank.

Labor saving is estimated at 36,000 man-hours during first fifteen months of construction. Cost comparison of individual units versus central system goes as follows: (A) *Individual system* — 104 machines, cable installation to and from welders—$74,000. (B) *Central system*—Three silicon rectifiers, 104 resistors, primary dc installation and welding cable—$49,000. Difference: $25,000. Add operational savings of $62,500, and the total becomes $87,500.

Jersey Central has decided to keep the installation (at the moment on a temporary construction basis) as a permanent maintenance tool. They will place two of the rectifiers at other stations for a similar setup there, and leave one rectifier at Sayreville.

System accommodates 104 weldors, with a diversity factor of 30%. Rectifier capacity is handled by three units for highest reliability and best economics. Above 2000-amp capacity, cost per ampere output rises rapidly, so 1500-amp continuous rating rectifiers were chosen for 80-v dc service. To date, 100 weldors working at once draw 4500 amps, maximum.

Overload margin is 50% for two minutes without overheating. Each rectifying unit operates in parallel with the others with a maximum load unbalance of 10%. Voltage regulation is within 4% from ¼ to ¾ load, and maximum of 7.5% overall. Result: faster, more uniform welds and elimination of arc blow as a problem. No defective welds were found during the process of testing and radiographic work.

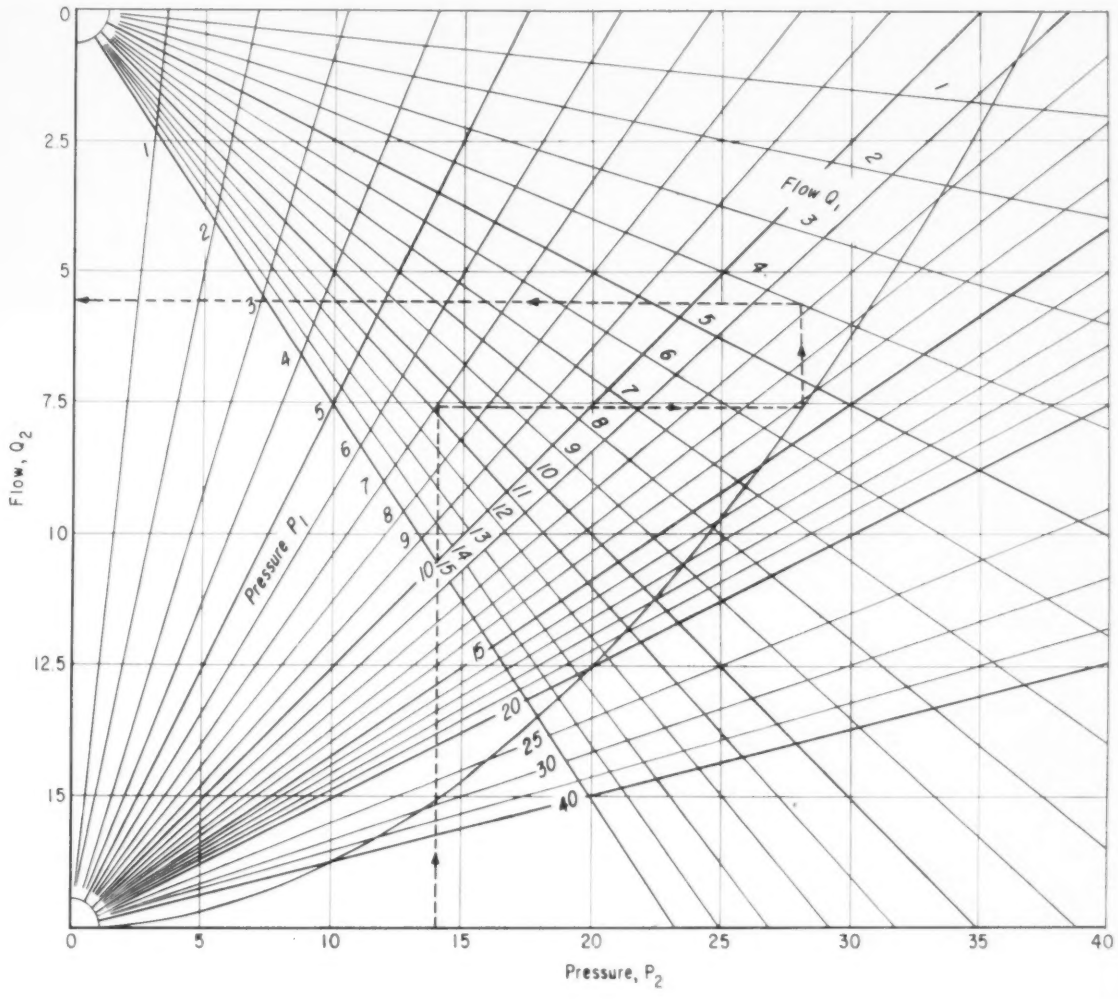
Maintenance is simple. During the first 1800 hours of operation, repairs were nil. Until reliability was proven, a stock of spare parts was kept on hand for servicing units in case of failure. These were returned after six months as not needed.

We keep units in good condition by (a) blowing dust off silicon cells with low-pressure air (b) checking cleanliness and tightness of electrical connections (c) examining insulation (d) checking operation of safety devices and (e) stopping any structural corrosion by cleaning and repainting.

Perforated for your filing ease

Power's data sheet

No. 313



How change in gas pressure affects gas flow

If the feed pressure on your gas burners change, how will it affect the flow? This chart gives you an answer quickly if you know your original pressure and the corresponding flow. It is based on the formula:

$$Q_2 = Q_1 \sqrt{P_2/P_1}$$

where the Q's are initial and changed flow rates, and the P's initial and changed feed pressure at burner. Here's how to use the chart:

Your burner now passes 40 cfh of gas with a feed pressure of 7 oz per sq in. How much gas will flow when feed pressure at burner rises to 14 oz per sq in.?

Enter the chart at $P_2 = 14$ and trace vertically to $P_1 = 7$. Move horizontally to intersect curve, then vertically to intersect $Q_1 = 4$ and read $Q_2 = 5.6$. Since we used a factor of 10 on Q_1, the new flow will be $5.6 \times 10 = 56$ cfh.

P's must be in same units as well as the two *Q's*.

By P Hahn, *Norristown, Pa.*

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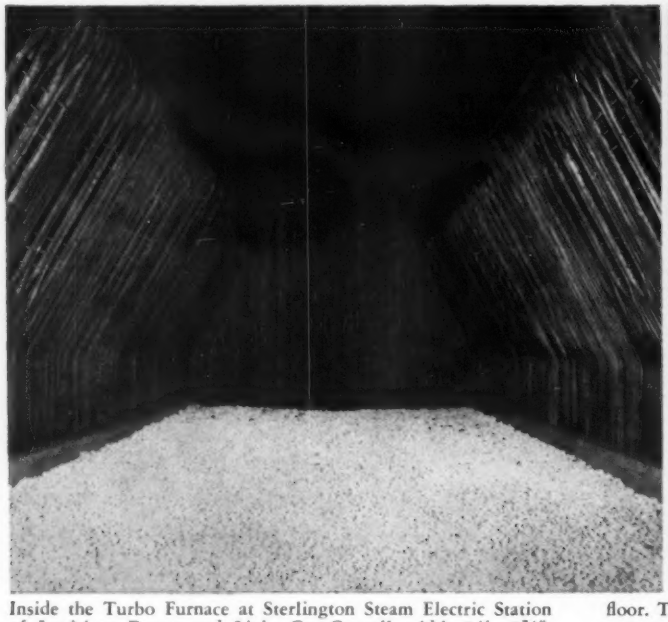
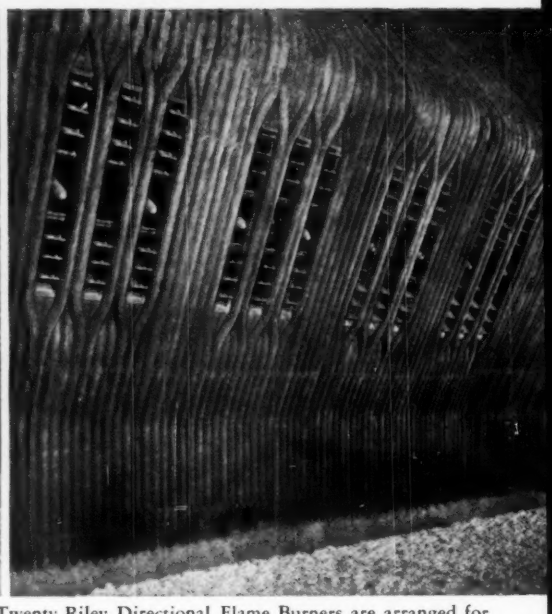
Specially Designed RILEY Efficiently Fire Multiple Fuels





Inside the Turbo Furnace at Sterlington Steam Electric Station of Louisiana Power and Light Co. Overall width 54′—7⅞″, depth 24′—0-⅜″. No. 1 firebrick rubble covers the furnace floor. Twenty Riley Directional Flame Burners are arranged for opposed firing on front and rear walls. Burners are shop fabricated assemblies. Burner close-up shows directional vanes, two

The Riley TURBO FURNACE unit is one of the major furnace design advances in recent years for the more efficient utilization of fuels. It is known as a multifuel unit primarily because of its ability to produce similar furnace exit gas temperatures with gas, oil, coal or other solid fuels. This phenomenum is due to the fact that natural gas, which ordinarily burns with a non-luminous flame, burns in a TURBO FURNACE with a luminous flame similar to oil and coal. In a TURBO FURNACE, fuels are burned with extremely high turbulence at the furnace bottom; in the case of pulverized coal, over a slag pool. Much of the unusual combustion efficiency is due to opposed firing with Riley Directional Flame Burners specially designed for firing multiple fuels singly or in combination. These fuels may be pulverized coal, oil, gas, or other special solid fuels such as fluid coke or lignite.

Water Cooled Burner

The Riley Directional Flame Burner is designed for opposed firing on one level. Each Riley Directional Flame Burner is installed as a unit complete with water cooling tubes which are welded to the waterwall circulation system. The waterwall tube arrangement provides maximum cooling of directional vanes, nozzles and other burner parts and reduces to a minimum the possibility of slag adhesion when coal is being burned. No burner refractories are required.

Coal Burning

Two or three burner nozzles per burner are provided when coal or other solid fuels are to be burned. In this way the coal streams are more evenly distributed across the furnace to assure good mixing of fuel and air in the furnace.

Oil Firing

A retractable type oil gun is inserted thru the center slot so as to provide complete mixing of the spray with the air stream. Oil can be burned with either steam or mechanical atomizing equipment.

Gas Firing

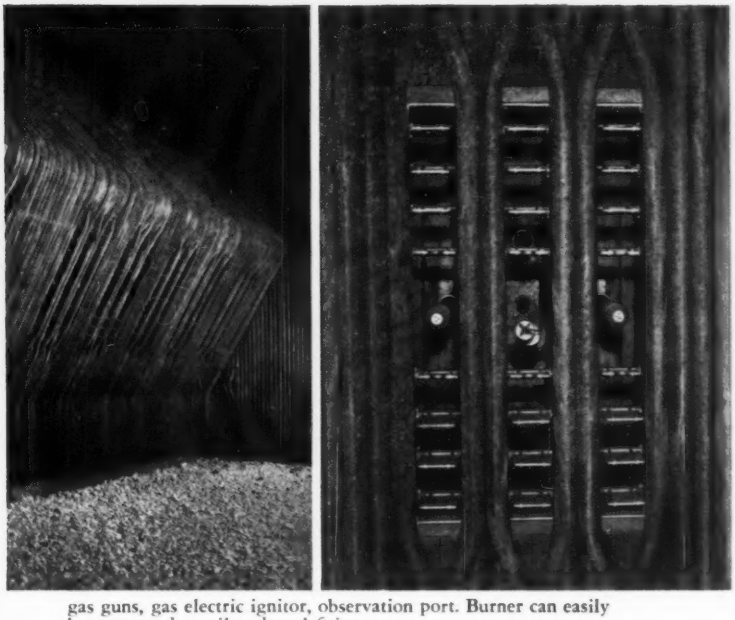
Gas is fired thru guns of high alloy stainless steel. High capacity burners have a gun in each side slot. Gas guns can be installed for mechanical retraction.

A RILEY TURBO FURNACE GIVES YOU THESE MONEY-SAVING ADVANTAGES

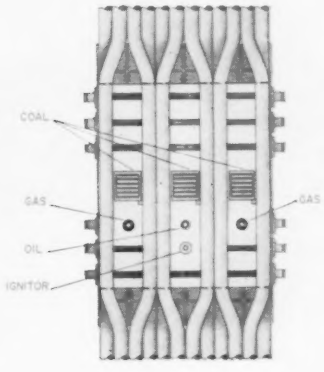
- **The ability to fire multiple fuels: gas, oil and a wide range of solid fuels**
- **A low cost and quick conversion to solid fuels with initial gas/oil firing**
- **Higher heat release with lower overall structure**
- **When firing coal**
  low carbon loss
  clean furnace, no slagging
  elimination of flyash removal with reinjection
- **One level burner operation**

TWENTY THREE RILEY TURBO FURNACE UNITS HAVE BEEN SOLD SINCE ITS INTRODUCTION IN LATE 1954!

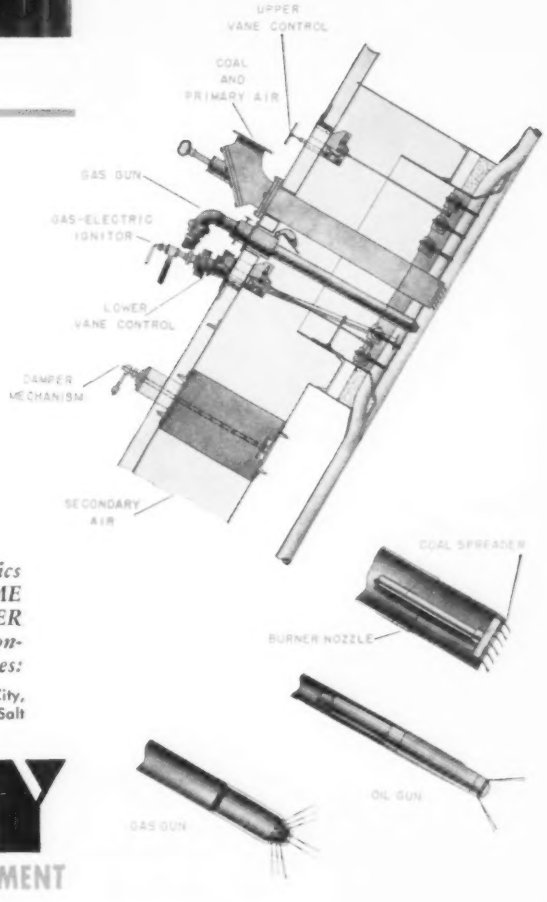
Directional Flame Burners in a RILEY TURBO FURNACE



gas guns, gas electric ignitor, observation port. Burner can easily be converted to oil and coal firing.



RILEY
DIRECTIONAL FLAME BURNER
Pulverized Coal, Oil and Gas



Directional Vanes

Each slot is provided with directional vanes to project secondary air into the furnace so as to secure the desired placement of flame for most effective combustion. The vanes above the burner centerline and those below each have separate controls. Vanes are made of high heat resisting alloy.

Burner Shut-Off

Each burner has a separate secondary air shut-off damper which can be locally or remotely controlled.

Riley Gas-Electric Ignitors

Riley Gas-Electric Ignitors are available with Riley Directional Flame Burners.

Pressurized and Non-Pressurized Operation

Riley Directional Flame Burners are designed so that they can be used either with pressurized or non-pressurized furnaces.

The complete story about the unusual operating characteristics of the Riley TURBO FURNACE and DIRECTIONAL FLAME BURNERS can be obtained by writing RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS or contacting a Riley representative in any one of these cities:

Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.

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STEAM GENERATING & FUEL BURNING EQUIPMENT

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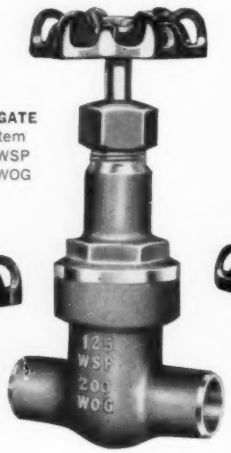
O-B VALVES

No. 2800 GATE
Non-Rising Stem
125 lbs. WSP
200 lbs. WOG



No. 2900 GATE
Rising Stem
125 lbs. WSP
200 lbs. WOG

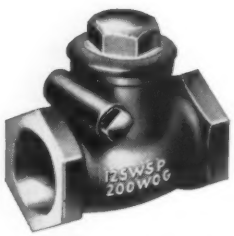
No. 2400 GATE
Non-Rising Stem
100 lbs. WSP
150 lbs. WOG
Also available with Drain

No. 1606 SWING CHECK
125 lbs. WSP
200 lbs. WOG
Brass, Composition or
Leather Discs

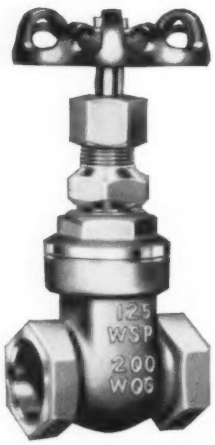
No. 601-X GLOBE
100 lbs. WSP
150 lbs. WOG
Soft Disc. Also available
in Angle or with Drain

No. 1601 GLOBE
125 lbs. WSP
200 lbs. WOG
Composition Disc. Also
available in Angle

O-B VALVES with braze ends



No. 6606 SWING CHECK
125 lbs. WSP
200 lbs. WOG
Brass, Composition or
Leather Discs



No. 6500 GATE
Non-Rising Stem
125 lbs. WSP
200 lbs. WOG

No. 6700 GATE
Rising Stem
125 lbs. WSP
200 lbs. WOG

Here's why...

It takes only minimum torch time to bring valve ends to proper soldering temperature . . . even heat distribution results in better solder flow for a leaktight joint.

Ask your Ohio Brass Distributor about the complete line of O-B bronze valves. Or write to:

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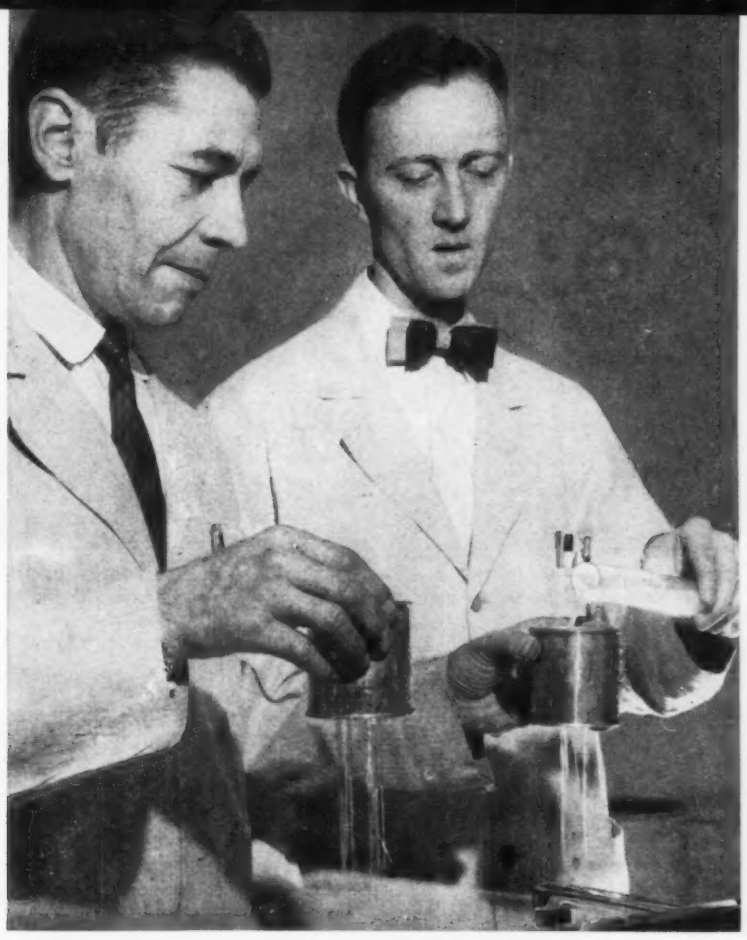
Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge



WATER pours out of untreated can, but sealant, *right*, has plugged some holes already

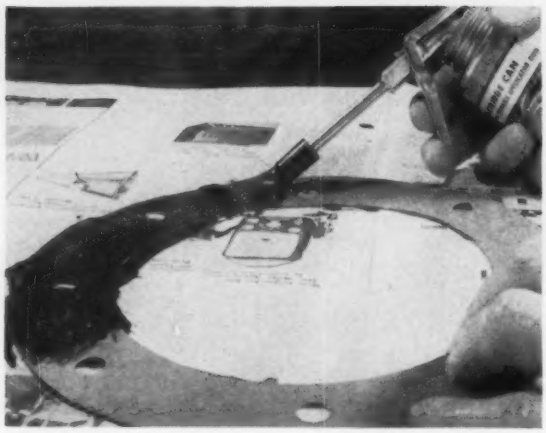
Knowing your sealants can save you money

By W M LANGTON, Chemist, Permatex Co, Inc

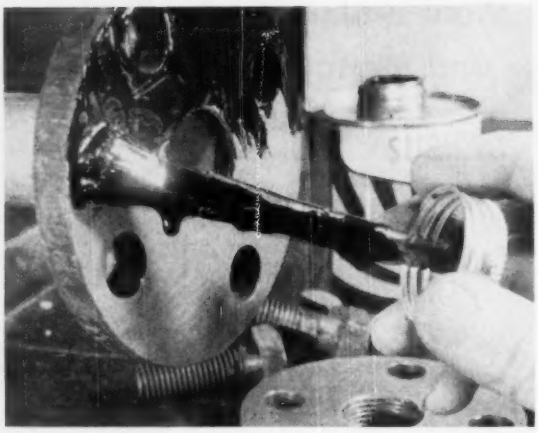
One drop of water leaking from a pipeline every two seconds wastes 54 gallons of water per month! If the leak is more severe, such as from a 1/32-in. diameter hole in a line at 60-psi pressure, the loss is more than 20 gallons per day. Aside from repairing a messy condition in your plant, fixing the leak means money in your pocket and a neater plant.

You can do two things about leaks: prevent them or fix them. To prevent them, use proper pipe-joining compounds to make your system watertight. But if leaks do develop later, try aqueous-system sealers. These will plug smaller leaks so you won't have to dismantle all your piping when tackling the problem.

A laboratory demonstration, photo above, shows what happens when you add aqueous-system sealer to a leaky pipeline. Both cans were drilled full of 1/32-in. holes. Water pours freely out of can on the left. But, sealer poured into the can at the right has



GREASE GUN type can for sealant comes in handy. Tip has a toothed spreader, helps get uniform coating of right thickness



FLANGED JOINTS are leakproofed. Apply sealer to flange faces. Use hard-setting compound if joints are to be permanent

Here are things you can expect sealants to do and some tips on

already plugged some holes. All holes will soon be sealed—government specifications demand that a hole stop leaking within 10 seconds after introduction of the sealant.

A cooling system, circulating some 4000 gallons of water, developed leaks last summer during its trial run. Rather than tear out and reassemble all piping in the 10-story building, engineers stopped the leaks by adding 55 gallons of water-system sealer. Same results were achieved in a heating system, where lengths of pipe had already been embedded in concrete.

There are several things to remember about the aqueous-system sealer. As the name implies it works only in closed liquid systems, not in gas lines. But the fluid doesn't have to be water. Brine is all right; so are other fluids that won't attack the resin sealer and are not hampered by introduction of asbestos fiber into the sealer.

System temperatures from below freezing to more than 500 F are OK. So are pressures up to 50 or 60 psi, as witnessed by the 10-story building. Vibration has no effect, and the inert materials used in the sealer will not react with any piping materials or solders. Another important feature: sealer won't harm centrifugal or positive-displacement pumps.

One caution—take out all strainers before introducing the sealer. Otherwise, you remove the asbestos fiber, defeating your purpose. You also put a strain on your pumps by increasing system pressures. After leaving the sealer in the system for at least a few hours (preferably overnight), flush it, then reinstall filters. If system has no filters,, sealer can be left in to take care of any leaks that might develop. Usual ratio of one part sealer to 80 parts water will handle your primary sealing job, and still leave you with enough of a reserve to handle future needs.

Two common methods are used to get sealant into the system: (1) Drain system, open up suction leg of pump, then let pump draw in sealant and refill with water. (2) Open system near its highest point and let sealant flow in by gravity. A permanent connection — with bypass— can be made, if desirable, for periodic reintroduction of sealant. But this is usually not necessary. It's best to treat every six months for preventive maintenance.

Liquid and paste sealants fall into three classes: hard-setting, flexible and soft-setting. Use hard-setting when a permanent seal is desired, flexible where occasional dismantling is necessary or where vibration is a factor. Soft-setting compounds generally have low viscosity, and are used primarily as pipe dopes.

Most sealants have some or all of these constitutents: oils, resins, fillers and solvents. Oils and resins usually harden upon exposure to air to do the actual sealing. Solvents allow viscosity to be lowered for easy application. Fillers not only reduce final cost, but also add strength and hardness, heat resistance, insulation and a certain useful working consistency.

To select a sealant, consider the following:

(1) Product to be sealed. Sealant, after application and assembly, should not be affected by the fluids in the system. Obviously, don't use a water-soluble sealant for an aqueous system. But we do make one sealant which is completely unaffected by any solvent *except* water!

(2) Pressure. Hard-setting compounds are usually able to contain higher pressures, the exact pressure depending on pipe size, type of joint, workmanship, etc. If a flexible or soft-setting compound must be used, special joints, such as flared unions, are best.

(3) Temperature. Many sealants made with organic compounds will start to decompose at 400 F.

THREADS can be coated with stick, spatula or a stiff brush for field applications

how to select them

Also, hard-setting compounds tend to crumble as joint expands and contracts with repeated changes in temperature. If a standard sealant does not meet your requirements, consult manufacturers who offer the technical assistance of their labs. Generally, sealants for service above 400 F will be more expensive, because they are made to special order and contain more expensive ingredients.

(4) External environment. On piping that runs outdoors, be sure sealant is waterproof. Or, if water-soluble material is best for the type of seal needed, you can paint over the sealant or otherwise protect it against the weather.

Remember, best procedure is to prevent leaks in the first place. Good workmanship is insurance for a leak-proof system. Fittings won't leak if properly drawn up, and if the right pipe dope is used. Flanged joints should have proper gaskets, with sealing compound on both sides.

Sealing compound is simple to apply. A stiff brush, spatula or clean stick will do the job. In some cases, sealant even comes prepackaged in its own "grease gun," has a spreader attached to give an even coating of the right thickness. Be sure pipe thread or flange is clean before putting on compound. Don't use too much, and always apply to external thread. Otherwise excess will be forced into the system.

Table, above, shows the range of chemicals which can be contained by the proper sealant. In this list of materials to be sealed, sealants are characterized by their bases. Actually, extenders and modifiers such as inert fillers play a great part in the formulation of sealants. Their use is largely determined by job the sealant must do.

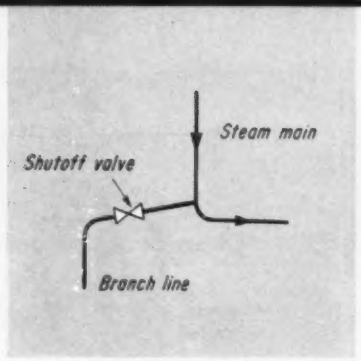
Extenders and modifiers are sometimes used to save money, but proper use of these materials can also improve the sealant. They give desired body, added heat resistance and improved cohesion. The list above should be examined while keeping this thought in mind.

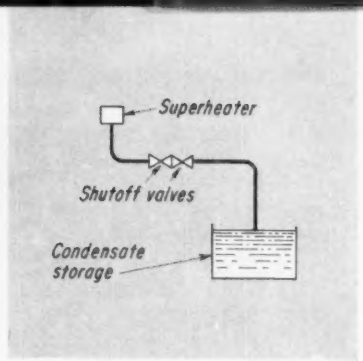
Litharge and glycerin in correct mixture are often used for almost every application in the table. But the ingredients must be kept separated until the moment of application. Then, you must take great care in determining the degree of plasticization by varying the proportions of the materials or you'll have trouble.

Chemicals contained by proper sealant

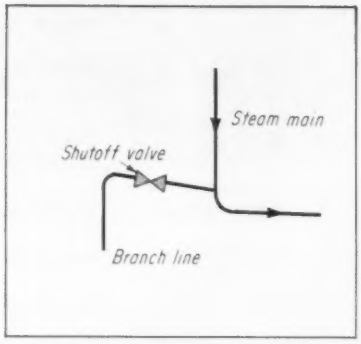
Materials to be sealed	Base of sealant
Acids	Chemically inert, low acid number and unsaponifiable type of resins—mineral rubber
Alcohols	Alcohol-insoluble synthetic resins and insoluble natural gums
Alkalis	Chemically inert, low acid number and unsaponifiable type of resins—mineral rubber and pitches
Aviation fuels	Insoluble natural gums and synthetic resins
Diester lubricants	Same as aviation fuels
Esters	Insoluble natural gums
Glycols (100%)	Insoluble natural gums and synethetic resins
Hydrocarbons, aliphatic	Insoluble synthetic resins, rubbers and polymerized heavy-bodied vegetable oils
Aromatic fluids	Insoluble synthetic resins and insoluble natural gums
Chlorinated fluids	Insoluble natural gums
Hydraulic fluids, petroleum based	Polymerized, heavy-bodied vegetable oils, insoluble synthetic resins and insoluble rubbers
Water glycol	Polymerized, heavy-bodied vegetable oils and insoluble synthetic resins
Phosphate esters	Insoluble natural gums
Ketones	Insoluble natural gums, and insoluble synthetic resins for higher molecular-weight ketones

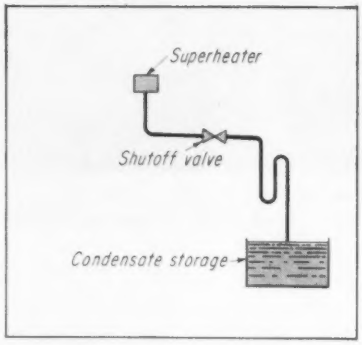
Valve arrangements like these can give trouble





These hookups help assure tight-closing valves





1 Slight change in slope of branch-line piping drains condensate into steam main, stopping recurrent valve leakage

2 Piping loop seal between stop valve and condensate storage stops corrosion by keeping air away from the closing parts

Valve and piping hookups: key to tight

Fuel and maintenance charges zoom when steam valves continue to leak despite constant repairs. That's why it pays to study effect of system hookup on valve corrosion

Some plant engineers are pessimistic about ever keeping all their steam valves tight seating. Valve seats and disks can be cleaned and polished to restore tightness. But it usually isn't long before they start leaking again. This might even be the psychological reason behind neglected valve maintenance in many plants.

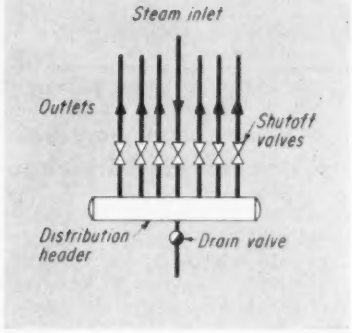
It's almost impossible to list all the drawbacks of steam valves that don't close tightly. From an economic standpoint, the resulting increase in steam consumption ups plant operating cost. And continued valve repairs are expensive since they're made during shutdown and paid for at overtime rates.

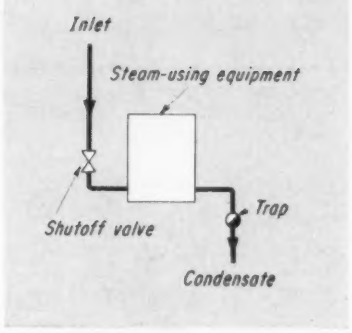
Plant heating systems warm up through valves that are supposed to be closed. Room temperature increases enough to decrease worker ambition and ability to produce. In textile mills and tobacco factories, higher temperatures with resulting lower air humidity affect product quality as well as workers' productivity.

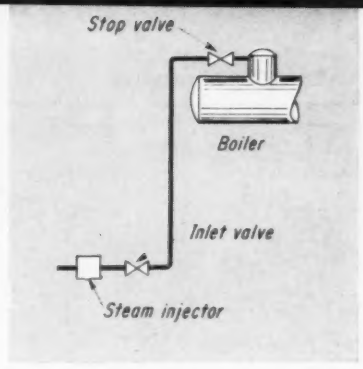
Tight-closing valves are needed for any process where steam pressure or temperature must be controlled. But often these drawbacks are ignored until repairs *must* be made to keep the plant operating.

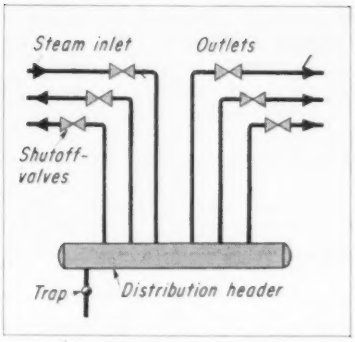
Why does leakage continue despite regular steam-valve repairs? There are many opinions about this. Some feel that poor valve seat and disk material is the cause. Others believe that high-velocity steam flow damages closing surfaces of the valve. Still others believe solids such as rust particles or scale are at fault—as the valve closes these particles press into finely polished valve surfaces and provide a passage for escaping steam. But my experience points to valve corrosion as the real culprit in most cases.

Drainage design measures are usually taken to protect the system against water hammer, improve heat transfer, avoid danger of freezing and prevent damage to steam engines. In these areas, the effect of small amounts of residual condensate is negligible, which perhaps accounts for the incomplete drainage of most lines and valves in actual practice. So small amounts of condensate will accumulate on closing surfaces of valves.

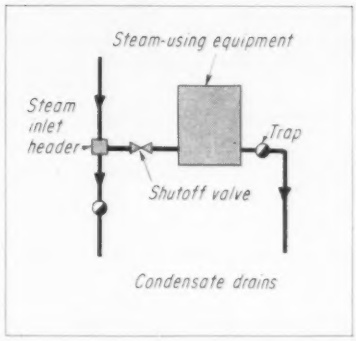




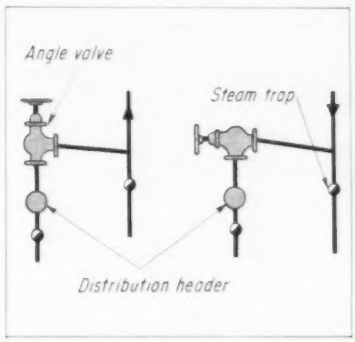




3 Changing shutoff valves from vertical to horizontal position keeps condensate away from valve internals during shutdown



4 Inlet valves on steam-using equipment are corrosion targets at shutdown unless condensate is completely drained



5 Valves, *top sketch*, gives trouble unless they operate in right sequence. Angle valves, *above*, will always drain freely

seating steam shutoff valves

By MARCEL STEIN
Mechanical Engineer

Any air in the system brings oxygen in contact with this water to produce an active corrosion cell.

Galvanic current is then produced between the areas of high and low oxygen concentration in the water. Actual corrosion, or loss of metal, happens at the place lying farthest away from water level. Here the oxygen concentration is lowest. No corrosion is observed at water level where oxygen concentration is highest.

Oxidation builds up a protective film on metal surfaces which resists further corrosion. When valves are opened and closed, protective film on the seat and disk is effectively destroyed by rubbing. So corrosion continues at these critical points if they are under water level.

Corrosion damage takes the form of pin-point holes that gradually increase in size under the influence of galvanic current. Ultimately the entire surface is perforated. All that's needed is a small amount of water in the presence of oxygen. Not even the more corrosion-resistant materials such as stainless steel are immune. Let's examine actual situations where it's almost impossible to maintain tight-seating steam valves.

Fig. 1 shows a steam main that's used constantly except on Sundays and holidays. But the branch steam line operates only once or twice a day for short intervals. And the quantity of steam flowing through the branch line is small. Steam escaped through the closed valve despite repeated repairs. The valve seat was tight after each repair, but it would soon start leaking again after the week-end shutdown.

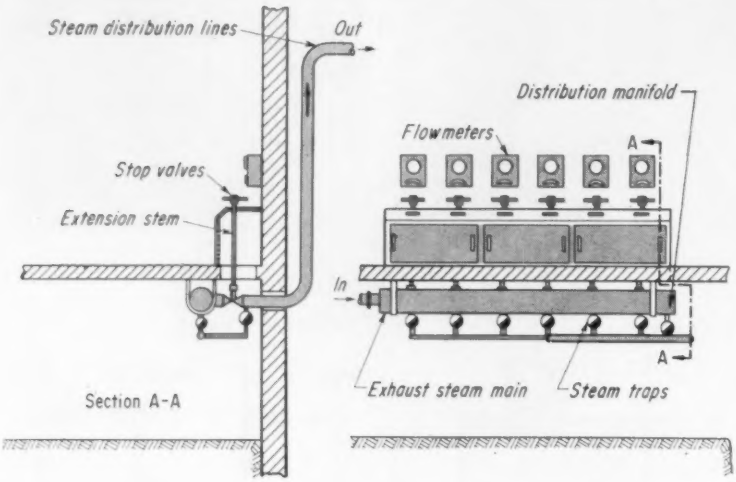
Tempered stainless steel seat and disk valve was then tried. Even with this improved construction the leak reappeared after shutdown—following repair, valve leaked just as much as before.

Finally the branch steam line was altered slightly to make it slope upwards toward the valve. The amount of this ascent was small in degree, but it was enough to correct the valve trouble. After one final repair the valve remained tight.

Another interesting case is shown in Fig. 2. The operators couldn't get tight shutoff of the superheater drain valve. And valve repair wasn't possible while operating the 350-psi boiler. The waste of live steam during this period was considerable. A second valve installed in series with the first one gave only temporary relief. Substituting higher-quality valves didn't stop the steam waste either.

A simple pipe bend between the storage tank and the drain valve finally solved this problem. Additional valve repairs were then unnecessary.

In both cases: (1) valves were almost continuously



Exhaust-steam manifold design has good drainage

Distribution manifold has six branches installed below the ceiling. Valve spindles have lengthening rods for easy manipulation from above. Handwheels are on the operating table. Ceiling over valves is cut out, giving access to stuffing box when front plate sections of operating table are removed. Branch lines pass through wall below ceiling and run vertically along wall of adjacent space. Flowmeters on wall give steam flow in each branch line. Steam trap on the low point of each line keeps the system automatically drained.

closed (2) steam flow was small (3) same valves were used before and after the successful solution and (4) alterations made didn't change the possibility of solids injuring the closing parts of the valves.

So failure of these valves to obtain a tight seat cannot be explained by incorrect valve materials, excessive steam velocity or solids lodged in the closing parts of the valve. Otherwise the alterations wouldn't have suddenly made the valves tight-seating. And there's no reason to assume that any solids present just disappeared when the piping was changed. That leaves valve corrosion as the logical cause of trouble.

Feedwater was deaerated, so the valves didn't corrode during continued operation. But during a shutdown it's practically impossible to keep oxygen out of the system. Vacuum created by condensing steam literally sucks in air wherever there is a small leak.

How did piping changes stop the valve corrosion causing the leakage? In Fig. 1, condensate accumulated in the branch line sloping down toward the valve. During shutdown this condensate came in contact with any system air leakage. Galvanic currents built up and attacked the closing surfaces of the valve farthest from water level. This explains why leaks always happened right after shutdown at deepest point of water column. Changing branch-line slope kept condensate away from valve by draining it back into the main.

Mixture of steam and air going through the valve caused corrosion in Fig. 2. Some steam condensed on the valve case, and, in presence of air, corroded valve surfaces covered by condensate. The U-shaped pipe gives a water pocket to keep air and vapor away from valve.

From these two illustrations we can see that steam valves can be made tight-closing if condensate is drained completely away from their closing parts. Elimination of air will do the same thing, but it's practically impossible to eliminate air in most systems.

Let's look at some typical piping and valve systems and see what changes will improve corrosion resistance and prevent recurrent trouble from steam valves that don't seat tightly. The changes are often very simple.

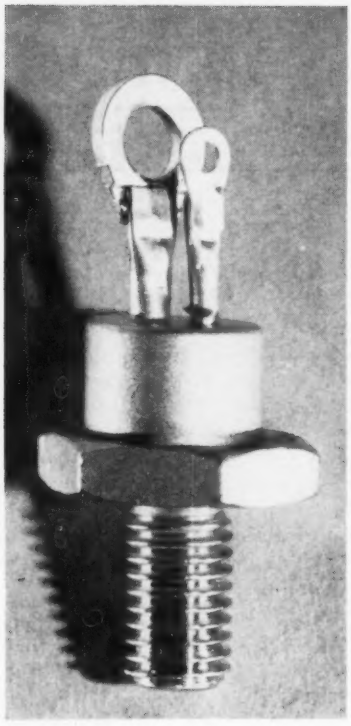
Steam distribution manifold in Fig. 3 has stop valves with horizontal spindles on the joining branches. During a shutdown condensate will accumulate above these valves. Practical experience with this type of hookup proves that valve leakage is a problem. It only takes a drop of water to start corrosion. If any part of closing valve surfaces is covered by condensate, corrosion damage is inevitable. Lower half of this sketch shows arrangement that avoids this trouble.

Corrosion damage is probable when valves are mounted ahead of any steam-consuming device hooked up like Fig. 4. Companion sketch, bottom diagram, Fig. 4, shows a much better arrangement for this service.

Steam injector valve in Fig. 5 started to leak only a few days after initial installation. Repeated valve repairs failed to stop the escape of steam. Standard procedure for shutdown was to close both injector valve and stop valve at the same time. This prevented any steam waste in the connecting pipe. But valve troubles stopped when this procedure was changed. Operator now opens the injector valve whenever the stop valve is closed, so it's almost impossible for any condensate to accumulate in the line between valves.

Recommended hookups for angle valves are also shown in Fig. 5. Design aim is to eliminate any condensate buildup during shutdown. This layout, and those recommended in Fig. 1 through 4, may seem unusual at first glance. But they are practical solutions to the problem of maintaining tight-seating steam valves. Exhaust-steam manifold, above, is an example of this kind of piping and valve arrangement.

Manually operated drain valves will do the job too. Valves installed with the spindle horizontal will accumulate condensate on the closing surfaces. Unless a drain valve is built into the installation, and correctly operated, valve corrosion results. But how can you be sure that operators will regularly use drain valves? It's safer and more economical in the long run to improve your piping design and use automatic steam traps.



CLOSEUP of a controlled rectifier unit

CONTROLLED RECTIFIERS are new midgets that show promise for industrial controls

New semiconductor device enters industrial control picture

A new semiconductor control device, which promises to be useful in future industrial applications, has stepped out of the laboratory. Developed by the General Electric Company's Semiconductor Products Department, Syracuse, N. Y., it's called a *controlled rectifier*. Made from silicon, it resembles a transistor, but performs similar to a thyratron tube. Silicon controlled rectifiers are made up of three rectifying junctions in a *PNPN* arrangement. (For some background on semiconductor terminology refer to POWER, Dec 1956, pp 134-135, and March 1958, pp 106-109).

Conducting breakdown of the center junction can be achieved by applying an appropriate signal to a third lead, called the *gate*. The gate consists of an ohmic contact to the center *P* region of the semiconductor.

In the photo, above left, the stud is the anode, the larger eye terminal is the cathode, and the smaller eye terminal is the gate. When breakdown occurs, voltage drop across the device is very low. It's negligible compared with the impedance of the load. The controlled rectifier is, therefore, a static switch in which switching action is started by the low-powered signals applied to the gate. It's a very fast switch; breakdown occurs at speeds approaching a microsecond. Very small signals can be used to control relatively large anode-to-cathode currents.

Industrial applications envisioned for controlled rectifiers include replacement of relays, thyratrons, magnetic amplifiers, power transistors and control-circuit rectifiers. They hold promise for dc motor speed control, dynamic braking and regulated dc power supplies. Maximum anode-to-cathode current at present is 16 amperes. Ratings can be expected to go up as the device is developed.

Controlled rectifiers have been available to makers of control equipment on an experimental basis for several months. Recent improvements in their manufacture have made it possible to cut their cost in half. If these newcomers prove to have the mechanical ruggedness and long life typical of semiconductor equipment, they'll reduce maintenance problems of many controls.

OPERATORS' NOTEBOOK **122**

Today, you must

Here's how steam humidifies your plant

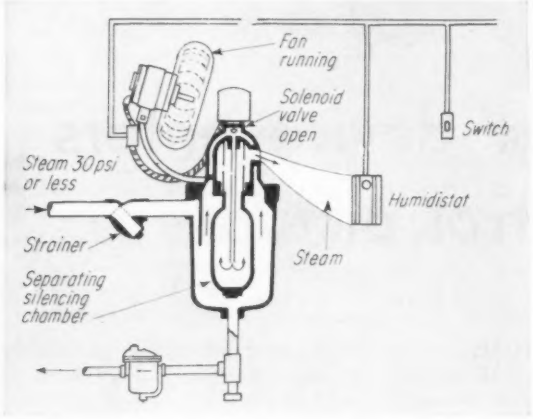
STEAM DISPERSED in the tannery reduces the electrostatic stress

There are several ways to control the relative humidity (rh) in your plant. Steam humidifiers can be connected to existing steam supply lines and electrical circuits to maintain any desired humidity. They provide large humidifying capacity at low cost by discharging clean, dry steam directly into the room air.

Installation of steam humidifiers follows that of unit heaters. They can be located at one or more points in the area, or installed to discharge into ducts or plenum chambers supplying heated air to the room.

On an average, steam for humidification costs about 1 cent per 1000 cu ft of space for a 24-hr day. Cost of electricity for operating a humidifier fan is about ¼ cent per hr if you pay as high as 3 cents per kwhr.

With outside temperature at zero degrees, inside temperature at 70 F, and two air changes per hour, steam needed to bring relative humidity up to 50% would add enough heat to raise room temperature only 2.2 F.

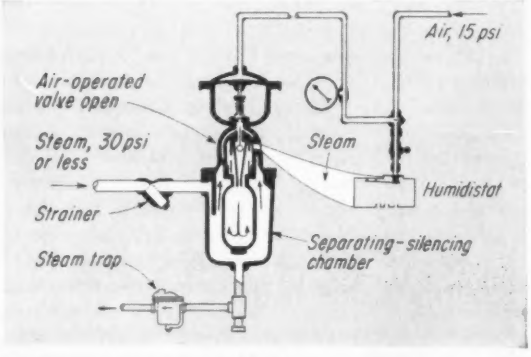


ELECTRIC FAN helps disperse the steam over a wider space area

When operated electrically, a drop in rh to slightly below the desired level causes a solenoid valve, actuated by the humidistat, to admit steam to the separating-silencing chamber. Steam passes from this chamber directly to the atmosphere. The fan helps disperse the steam. When rh reaches the desired level, the humidistat closes the solenoid and stops the fan.

As sketch shows, the steam trap drains any condensate that forms in the humidifier's body. Hot steam, surrounding the separating-silencing chamber, evaporates any condensate that might enter it. Thus, you're assured that only dry steam enters the room atmosphere.

Some units use fans to disperse steam; others rely on a steam jet to mix steam with the surrounding air.



AIR disperses the steam if flammable gases or dust are a hazard

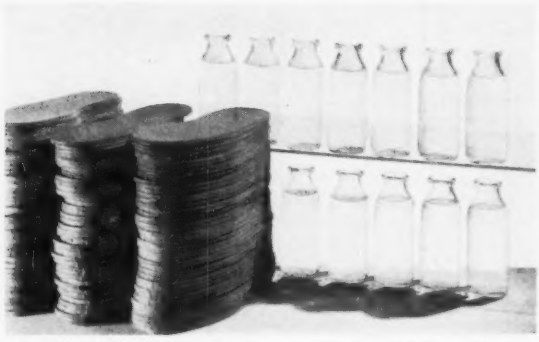
Avoid use of electric humidistats where flammable gases or dust create a fire or explosion hazard. Under these conditions, compressed-air-operated humidifiers are your best bet because they eliminate electrical circuits entirely. Air at 15 psi, or above, does the job.

In operation, lowered rh closes bleed in the pneumatic humidistat. This builds up air pressure on the air-operated valve diaphragm, opening the reverse-acting steam valve against spring tension. When rh reaches correct level, the hygrostat bleed opens, relieving pressure on the diaphragm. Spring action closes steam valve.

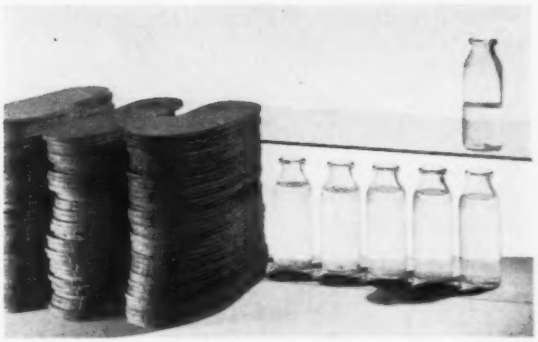
Evaporative unit, also common, picks up moisture from surface of heated water and blows into the spaces.

control relative humidity

By STEVE ELONKA, Associate Editor



AT 70% RH, 1 cu ft of leather contains about 12 pints of water



AT 23% RH, 1 cu ft of leather contains only 5½ pints of water

And, here's how rh affects hygroscopic materials

It's a fact that your company's profits depend a lot on the amount of moisture in your plant's air. From Halloween to Easter, your doors and windows are closed, heat is turned on some or all of the time. This dries out the air, causes all kinds of operating difficulties and losses.

Cost of dry air includes: (1) product deterioration (2) product and raw materials weight losses (3) fire hazard and other troubles from static electricity (4) dust, production difficulties (5) increased absenteeism from illness. But dry-air losses are often hidden or their extent isn't fully known. So absence of moisture often costs thousands of dollars during the heating season.

Relative humidity (rh) is the key to the problem. It expresses amount of moisture present in the air as compared to maximum amount air could hold at a given temperature. For example, an rh of 100% means the air is saturated—it cannot absorb more moisture at existing temperature. An rh of 20% means the air is one-fifth saturated—it could hold five times more moisture.

The warmer the air, the more moisture it can hold. Thus, 1 cu ft of air at 70 F can hold nearly 23 times as much moisture as 1 cu ft of air at 0 F. So, if air temperature is increased and no moisture is added, rh drops. When air at 0 F and 75% rh is heated to 70 F indoors, it has a relative humidity of only about 4%. But, between 35 and 50% rh is needed in most plants.

Don't forget that on cool or cold days, when rh outdoors is high, it's a lot lower inside your heated buildings. And, remember, dry air is thirsty air. If you increase air temperature without adding moisture, air will draw moisture from any available source. A sudden drop in outdoor temperature from 70 to 50 F may create dry-air problems indoors.

What should rh be? Your type of business determines the answer. American Society of Heating and Ventilating Engineers publishes a table showing rh for processing or storing a lot of different materials and products. But you can only maintain them during heating season by humidification. And control must be accurate. That means adding the right amount of moisture to your air as it's needed.

As photos above show, 1 cu ft of leather at 70% rh holds about 12 pints of water. But, if rh is lowered to 23%, the leather loses more than half its moisture. Excessive moisture loss will ruin the leather so it can never be restored even though moisture is again added. Other materials act in much the same way.

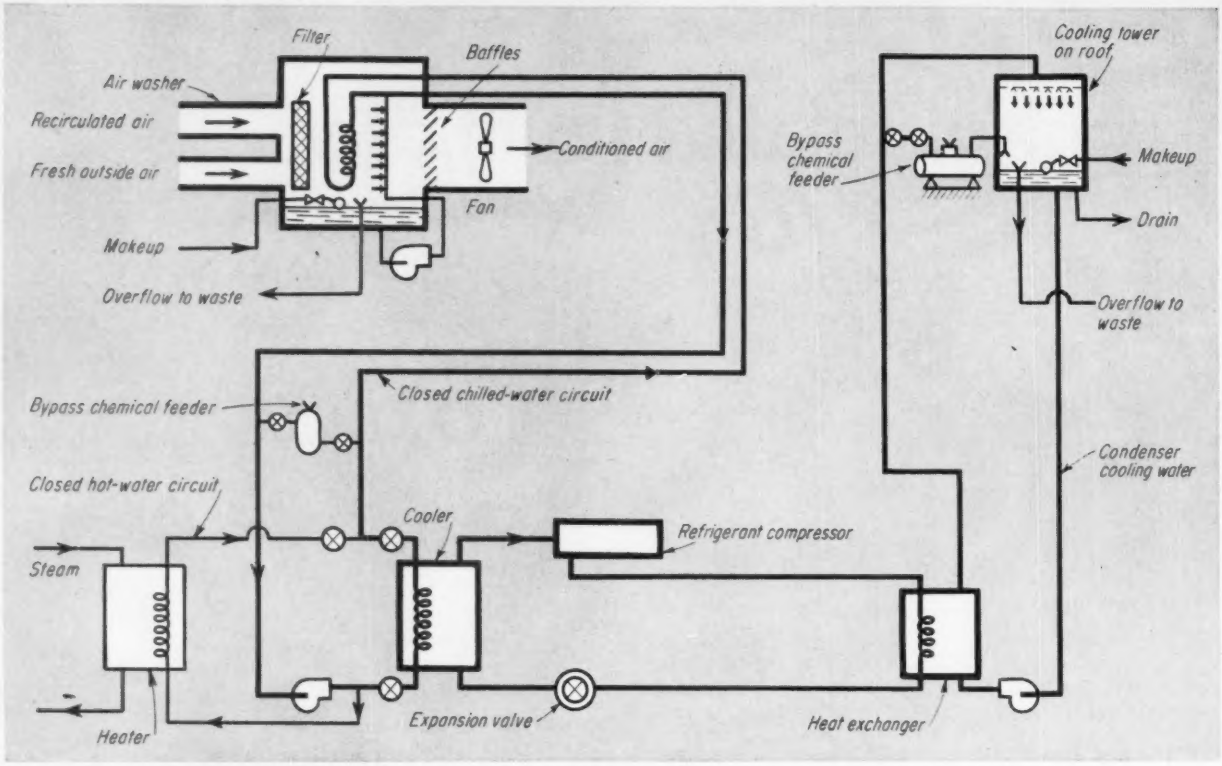
Comfort. Humidified air during winter is more comfortable and healthful than unhumidified dry air. A rh of 40 to 50% is usually best. Dry air in winter evaporates moisture from your skin faster than humidified air. And, it also removes moisture from your nasal passages and throat, making them more susceptible to air-borne germs.

Dry air keeps bacteria alive. Certain pneumonia germs survive for weeks or months when relative humidities are 35% or less. At 50% rh, these same bacteria die quickly.

Static electricity can mean trouble in many plants. It is caused by sudden separation of two bodies in contact. Examples: moving belts leaving the pulley; humans walking across the floor; dust particles blowing through a pipe; paper going through a printing press; etc.

Sparks from static are dangerous in presence of gases, volatile liquids or explosive dusts, such as in munitions plants, rubber-cement houses, paint-spray booths, flour mills and other places.

But static can be overcome, and one good way is by humidification. When rh is high enough (at least 50%), a thin film of moisture is deposited on surfaces in the room. Presence of normal impurities makes this moisture film a conductor that carries static electricity harmlessly to the ground.—*Courtesy, Armstrong Machine Works, Three Rivers, Mich.*



AIR-CONDITIONING SYSTEM uses bypass type chemical feeds in both chilled-water circuit, recirculated condenser cooling-water line

Corrosion, dirt, organic fouling raise havoc with air-conditioning and refrigeration systems. But, the right chemical treatment can . . .

Stop your cooling-water troubles

By W A MARTIN, The Permutit Company, Div of Pfaudler-Permutit Inc

Most cooling towers operate outdoors, where they are exposed to rain, sun, wind and freezing weather as well as to industrial gases from any flues and chimneys in the vicinity. Corrosion, dirt and organic-matter fouling create operating troubles. And, if the makeup source is a hard-water supply, scale is an additional problem, particularly in condensers.

Water, when it first forms as rain, is comparatively pure. But as it falls to earth and percolates through the ground it picks up oxygen, carbon dioxide and various mineral compounds. These impurities can damage piping, pumps, cooling towers and other water-handling equipment.

Carbon-steel alloys corrode or rust when exposed to water containing oxygen. Galvanized steel resists corrosion as long as the water doesn't contain enough acidity to dissolve the zinc coating. Even copper, impervious to attack in most waters, is often corroded by cooling-tower water. And all alloys are subject to scale, slime or algae formation.

Air-conditioning equipment, where a cooling tower or evaporative condenser is used, has treatment problems compounded by water evaporation. This gradually increases concentration of contaminants beyond their concentration in the makeup.

Cooling-tower operation tends to atomize the water. As these fine water drops fall through air they pick up air-borne dust, oxygen and other impurities much like an air washer or scrubber. Spores of organic life absorbed result in the formation of slimes and algae.

Metal corrosion, common trouble in cooling systems, is caused by acid condition of water, oxygen content and absorption of corrosive gases such as carbon and sulfur dioxide.

Acidity is controlled by adding chemicals to raise pH to an acceptable level. The term "pH" is simply a convenient way to classify solutions as acid or alkaline on a numerical scale ranging from 0 to 14. A pH

These simple field tests help you keep cooling water in top condition

Hardness test with APHA soap solution is quick and fairly accurate. Fill test bottle with a 20-ml sample and add soap solution one drop at a time. Count the number needed to make a lasting lather when bottle is shaken. Each drop after first ten equals 1-ppm hardness.

The pH level of recirculating and makeup water is easily found with a color comparator. Add indicator from calibrated dropper to a measured sample of water. Compare resulting color with standard color slides of known pH. Portable pH meters are also useful (POWER, May 1958, p 136). Put electrode directly into water sample and read pH from dial on instrument's face.

Chromate gives corrosion protection in the range of 300 to 600 ppm. So extreme precision isn't needed for this test. Take a sample of treated water and compare its color with standard color slides of known chromate content. This quick check shows if enough chromate is present in cooling water for protection.

Chloride concentration is a direct indication of solids buildup in circulating cooling water. Take a 20-ml sample and add five drops of phenolpthalein. If water turns pink, add N/10 sulfuric acid a drop at a time until the pink color indicating alkalinity is partially destroyed. Next, add five drops of potassium-chromate indicator. Finally, add N/7 silver-nitrate solution a drop at a time until a faint brick-red color develops. Each drop needed equals 12-ppm chlorides in the water sample.

Polyphosphate treatment is often used to prevent scale, particularly where cooling-tower makeup water is hard. Amount of polyphosphate in cooling water can be found in about 20 to 30 minutes with a color comparator. Take two samples of cooling water and boil one for 15 minutes. Add two standard reagents to hot sample and visually compare resulting blue color with standards to get total phosphate content. Repeat for cold sample to obtain amount of orthophosphate present. Polyphosphate is the difference between these two values.

of 7 indicates neutral water. Values below this show the degree of acidity and those above, alkalinity.

Excessive carbonate alkalinity (high pH) fosters delignification of cooling-tower wood. Lignin, the substance binding wood fibers together, is gradually dissolved and the cooling-tower fill eventually destroyed.

Painting or passivating protect the water-handling system from oxygen corrosion. Passivating, a process of adding a chemical inhibitor to water, results in formation of a film on the metal that's resistant to corrosion. Chromates are one group of chemicals that effectively passivate metal surfaces. But their yellow color may cause undesirable staining of adjacent areas from wind-blown spray. Adequate protection calls for chromate residuals in the range of 300 to 600 ppm.

Scale formation on condenser tubes and other parts of the system is an even more frequent trouble source. It increases resistance to flow in the condenser and seriously reduces heat-transfer efficiency. Scale is simply a deposit of inorganic salts or mineral matter in the cooling system. Evaporation of recirculated water in cooling towers and evaporative condensers gradually increases dissolved solids to the point where scaling can take place.

Bleedoff is the deliberate and systematic wasting of a small percentage of tower water to limit the concentration of scale-forming solids. Some form of chemical treatment is also needed to give complete protection.

Water-softening equipment is used to control scale formation in many cooling systems. All or part of the makeup is treated, depending upon the water analysis and cooling-system design. Both cold-process precipitation and ion-exchange softening are employed.

Soluble phosphates and polyphosphates as well as sulfuric acid are chemical agents used for scale control. The phosphate group acts as a sequesterant to prevent precipitation of insoluble mineral salts.

Polyphosphate threshold treatment generally calls for a residual of 2 to 4 ppm. Sulfuric acid is used to adjust pH. It converts mineral carbonates and bicarbonates to the more soluble sulfates. Handle and feed carefully since too much acid makes the water corrosive.

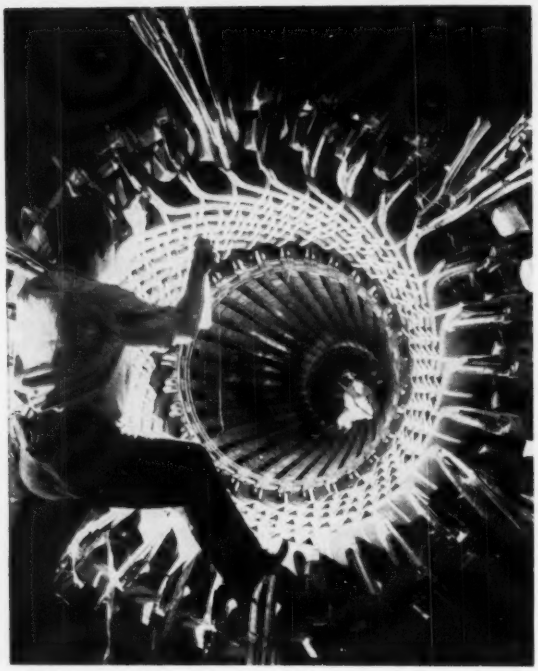
Organic growths such as slime and algae are highly undesirable in cooling-tower systems. They reduce flow through the system, act as a binder to plaster suspended dirt particles to tubing walls, and often create objectionable odors.

Chlorination is widely used to control organic buildup. But, since liquid chlorine is hard to handle in smaller systems, other organicides such as the chlorophenates and quaternary ammonium compounds are finding increased use.

Maintenance is the key to long life and top efficiency of any cooling system. Wash mud, algae, slime and any other dirt out of the tower at least once a year. Often a simple hosing down will do the job. Also clean the pan or basin, sumps, spray nozzles, etc. Remove condenser heads, inspect tubes and clean if needed. Check pumps and refrigeration system for leaks. Carefully examine equipment subject to vibration. Thoroughly clean and paint the pan and all exposed surfaces.

During the operating season, treat circulating water so it's neither corrosive nor scale forming and is free of algae and slime. Check the effectiveness of treatment by making the periodic tests outlined in box, above. Adjust bleedoff rate to maintain the desired level of dissolved solids in the recirculated tower water. Use chloride test for this control.

By NORMAN PEACH, Assistant Editor



WINDING STATOR for 2-pole turbine-generator requires working with heavy coils in limited space of long, narrow stator core

Electric-motor windings take a beating under the best of conditions. Some of them are bound to need rewinding from time to time. Power made a spot check of industrial plants to find out . . .

What is the best way to take care

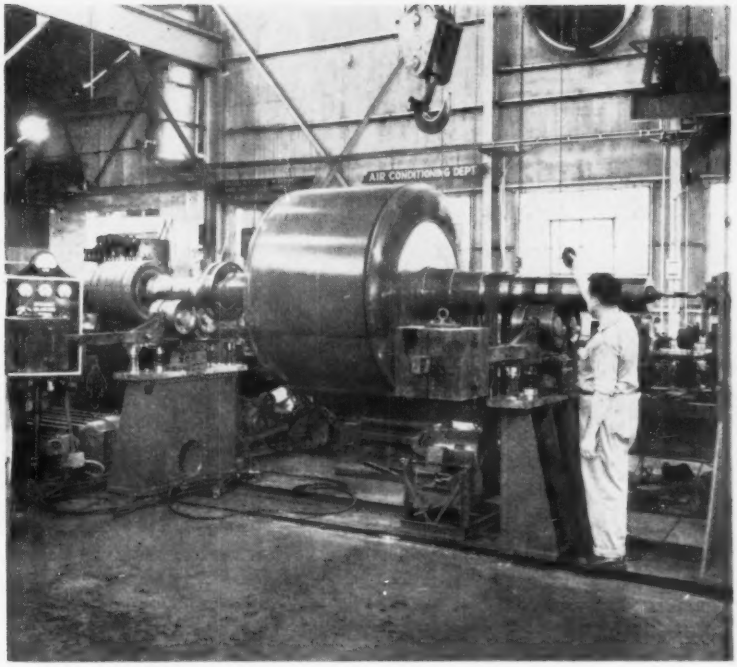
The most efficient and economical way to get electric-motor rewinding done today was the object of our spot check of industrial plants known to be maintenance conscious. We were also interested in learning what smallest horsepower motor is that it pays to rewind rather than replace under today's price setup. Inquiries indicate these trends:

It still pays to rewind 3-phase induction motors down to one horsepower, provided mechanical repairs aren't required. Some companies that were queried found they could get ½-hp standard 3-phase stators rewound for less overall cost than replacing them with new motors. One factor here is the change in frame sizes. If a new motor requires mounting changes, or else using a larger horsepower than otherwise necessary, cost margin generally favors the rewind. With fractionals, unless they have special features which can't be readily duplicated by motors on the suppliers' shelves, it's usually more economical to junk the burned-out motor and put a brand new one in its place.

Some manufacturers of single-phase repulsion-induction motors supply motor-repair shops with new rotors. In this case, a rotor rewind means slipping in a rotor wound in the factory under the same mass production conditions as new motors. Some manufacturers of fractionals offer an exchange of major parts or even complete motors.

Rewinding shops aren't maintained by most industrial plants, although quite a few larger companies do have them. Such "inside" shops take care of the bulk of motor rewinds up to 50 or 100 hp. Larger motors are generally sent to "outside" shops. Local independent motor repair shops will get the jobs up to 500 or perhaps 1000 hp; still larger motors will go back to the original manufacturer. Where redesigning of motor windings is concerned (apart from simple 220- to 440-volt changeover), the engineering is done by an outside motor shop or the manufacturer's staff. Plant engineers keep abreast of latest developments in the motor field, of course, and often make specifications, such as Class H insulation, encapsulation with epoxy resins, etc.

Many industrial plants have found they are better off turning over their motor rewinding to people who are specialists in this business rather than trying to keep their own motor shops up to date and staffed with competent winders. Chances are the outside shop is set up to do the job more economically, too. On the other hand, an inplant motor shop is more con-



DYNAMIC BALANCING puts finger on causes of vibration in rotating members. Rotor is for a 10,000-kw synchronous condenser; its exciter armature is balanced at same time

FRACTIONALS must be rewound by production methods to compete costwise

# of your electric-motor rewinds?

venient, especially if you are in a rather isolated location. And you can give priority to your more important motors since you are the only customer who has to be considered in the shop's schedule.

We also looked into some motor repair shops to see what kind of service they are prepared to give. Typical of a modern motor-repair shop is the Braunlich-Roessle Co in Pittsburgh. Their business is devoted exclusively to repair, maintenance and engineering of electrical equipment (motors, generators, hoists, magnets, rectifiers, etc) and doesn't get involved in wiring contracting. Most repair work is done in the shop, but several experienced trouble shooters are available for emergencies. Where desirable, equipment is kept on hand for rewinding in the customer's plant by repair-shop personnel.

Shop also has winding, pulling and taping machines which can turn out coils for virtually any kind of motor, including the odd dc old-timers still in use in some industries. All modern motor insulations are stocked and the shop has facilities for encapsulating field coils and stators in epoxy compounds. They are authorized for parts and services by representative manufacturers of motors, controls, hoists, etc, and many parts are stocked. Braunlich-Roessle, like many modern repair shops, is a member of the National Industrial Service Association (NISA).

NISA is the central agency for some 1600 member motor shops. Member shops include all classes of service. While some shops handle motors, generators and transformers of all sizes, there is a tendency to specialize. There are shops which take care of 50 hp and up, others which set 15 hp as the upper limit.

An important function of NISA is collecting, classifying, preserving and disseminating information. This includes rewind information gathered by the individual members and data on various materials used in motor repair, such as wire, insulation, brushholders, brushes, bearings, etc. Files are kept on shop tools and equipment, furnaces, testing equipment, and new processes. Rewinding data is collected from members and kept on file cards. This data-card library now consists of about 110,000 cards, with information on motors ranging from 1/125 hp up to 6600 hp. In addition to data obtained from members, most manufacturers have cooperated with NISA in supplying items of original winding data. NISA distributes important items of rewind data to its members in book form and stands ready to help them out with their individual problems.

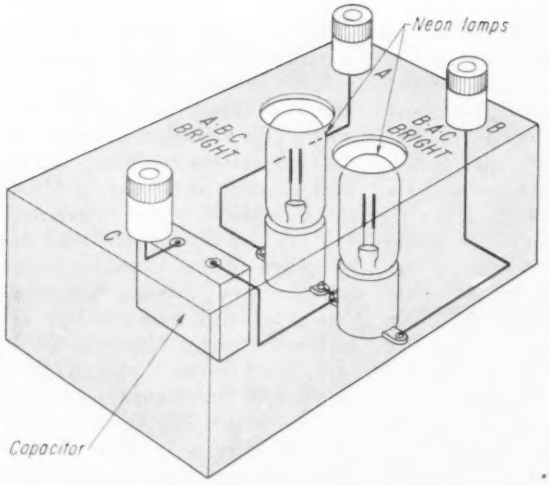
Plant Electrical Fact File

NO. 29: PHASE SEQUENCE

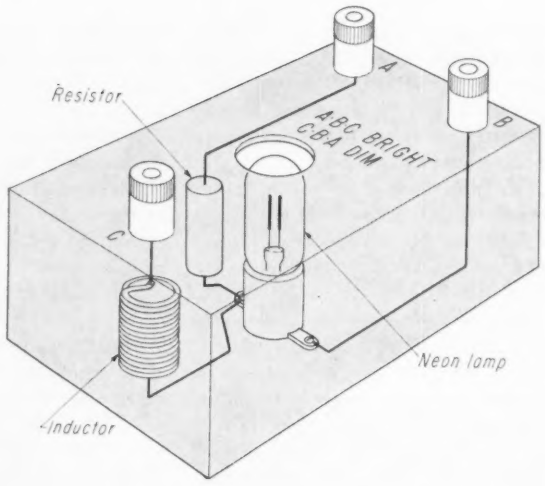
By NORMAN PEACH, Assistant Editor

Tips on testing phase sequence

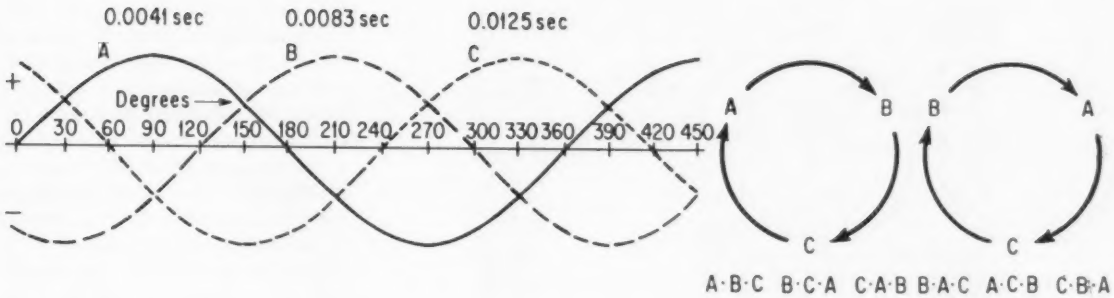
When making connections to 3-phase lines, it is sometimes important to know the phase sequence. Direction of rotation of 3-phase motors depends on the phase sequence. If a motor is to be installed where it is dangerous or impractical to try out rotation after hookup, examine the phase sequence of the line and check which phase sequence at the motor terminals gives the desired rotation before putting the motor in place. Three common types of phase-sequence testers are shown here. In the 2-lamp tester, an inductor can be used instead of a capacitor, but lamp *B* will be bright for *ABC* sequence, lamp *A* dim.



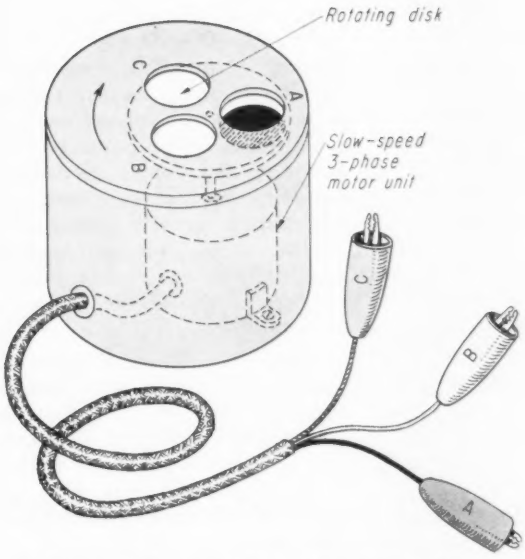
2 TWO-LAMP TESTER has capacitor in third leg of a wye connection. Phase displacement of capacitor causes lamp in leg *A* to be bright when sequence is *ABC;* lamp *B* is bright for *BAC* sequence. Impedance of capacitor equals resistance of one lamp



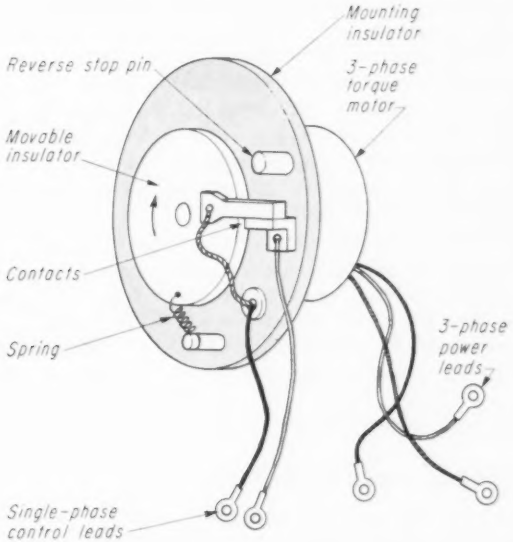
3 ONE-LAMP TESTER uses inductor for displacement. Lamp is bright with *ABC* sequence, dim with *CBA* sequence. Lamp in 1- and 2-lamp testers must be rated for line voltage; incandescent lamps can be used. Impedance of legs must be about equal



1 PHASE SEQUENCE indicates time sequence in which the three phases reach their maximum positive value. Two sequences are possible: *ABC* (the same as *BCA* or *CAB*) and *BAC* (the same as *ACB* or *CBA*). Conductors in important panels should be labeled. Physical layout may not be in sequence



4 ROTATING TESTER is simply a tiny 3-phase motor calibrated to rotate in the indicated direction when phase sequence is *ABC*. Tester's leads are marked accordingly. In type shown, motor turns disk; black spot appears under each lettered window



5 REVERSED-PHASE relays are used to disconnect power from equipment (such as elevators) if phase sequence is accidentally reversed. Type shown has small torque motor that holds contacts closed against spring tension when phase sequence is right

Timely **practical ideas** to help solve

We Want STAMP VIBRATION TOLERANCE
STAMP VIBRATION TOLER
WE WANT VIBRATION TOLERANCE STAMPED
MAXIMUM VIBRATION TOLERANCE STAMPED ON EQUIPMENT

My favorite gripe

Why don't manufacturers stamp vibration tolerances, based on amplitude and frequency, on their machines? Also, why not stamp the machine with the frequency level to which it has been balanced at the factory? These were my questions to the engineering department of Stewart-Warner Corp during a recent visit to Chicago.

My good friend, Ralph Buscarello, manager of their Industrial Balancer Dept, was pointing out the importance of checking the balance of rotating machinery at regular intervals. Fans, electric rotors, in fact everything that revolves should be checked periodically. Ralph pointed out that, in many cases, even if a wide-awake maintenance engineer does balance his equipment at set periods, he still doesn't know the maximum tolerances.

So the question came up about who is in the best position to establish the maximum vibration tolerances for any machines. I stated that the maker of the equipment certainly should know more about tolerances than anyone else. All agreed.

"OK," I suggested, "then why not start a campaign to have the makers stamp their equipment with this information—just as they do the maximum temperature rise on electric motors." I know, of course, that this is only a first step, that vibration is a complex subject. But this would be a pass in the right direction.

Too many machines fail because this information is not known. Let's hear from POWER readers — both manufacturers and plant maintenance men. We'll publish your thoughts on the subject in a roundup article.

STEVE ELONKA, *Associate Editor*
Maintenance and Management

Watch those air lines

Here are a few tips on reducing airline maintenance.

Installing. (1) Install a shutoff valve between the main pressure line and the operating circuit. (2) Use filters and regulators and apply correct lubrication. (3) If you have a remote-control system, place a bleeder valve as close to the master valve as possible since long bleeder lines cause erratic behavior. (4) Exhaust line should be as large as possible to eliminate any backpressure and prevent the exhaust port from plugging in the master control valve. (5) Clamp all high-pressure piping to eliminate whipping and possible breaking should a sudden surge occur due to a quick-closing control valve. (6) Install master air valves having solenoid-operated pilot control. Place solenoid in a vertical position so plunger falls freely when deenergized.

Repairing. (1) Before attempting to repair an air circuit close the shutoff valve between the main pressure line and the operating line. This done, exhaust the remaining air from the circuit. Operate any levers by hand to be sure all air is exhausted. (2) Never squeeze the cup packing on an air-cylinder system; excessive pressure has a tendency to curl the lips of the cup, thus losing the seal. Just snug piston screws to snug position and secure with locking wire. (3) Be careful when repairing split type trunions. Too much tightening may squeeze the tube and cause the piston to bind.

Servicing. Excessive shock is eliminated when the piston contacts cover the setting needles on the cushioned cylinders. After these precautions are taken don't neglect to service the installations. Drain water regularly and be sure to use a good lubricant.

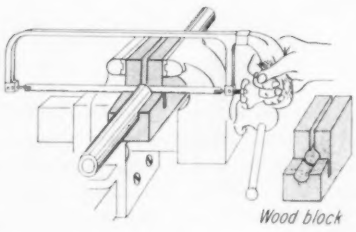
I've learned these tips the hard way, through experience, and know that they are sound. You'll make life much easier by following them.

B A CROSSON, *Cranston, R. I.*

Wood block holds tube

It will pay you to take the time to use a wood block, bored lengthwise and cut through the top, to hold tubing when cutting with a hack saw. Make the block of hardwood and step the end to allow for easy measuring.

C H WILLEY, *Penacook, N. H.*



Wood block

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

Save money on heat

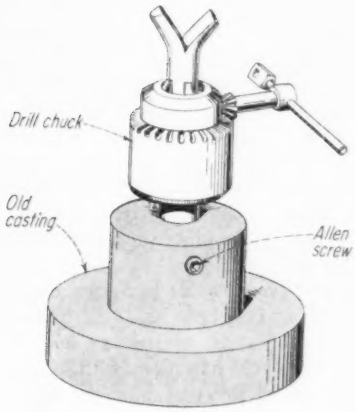
My vacuum pumps maintain 15 in. vacuum on return side of all radiators. But over a period of years, heating coils and return lines from process units have been piped into the return side of our heating system. This was done to save piping.

High-pressure traps discharging to return line caused vacuum to drop in that riser. So any radiators on that riser became difficult to heat.

To correct and save fuel, I made these changes: All returns from l-p and h-p coils were piped to supply side of our heating system. Larger orifices were installed in traps on supply risers to take care of excessive conditions.

Now all my tenants are happy. But best of all, our fuel bill has been greatly slashed. This change would really pay off for those who sell metered process steam at high pressures. Reason: h-p condensate would then go to heat building, which is usually sold at flat rate.

M E TYNAN, *Boston, Mass.*



Chuck makes third hand

By fitting a ⅝-in. drill chuck to an old casting, we made a convenient holding device for our bench work. Chuck is secured to casting by an Allen screw, sketch. It's very handy for brazing, soldering or filing.

C H WILLEY, *Penacook, N. H.*

What would you have done?

Over 50 years ago, a boiler maker named Dave Malone and I were sent to Seymore, Conn. to a horseshoe-nail manufacturing plant. Our job was to put a patch on their old vertical firetube boiler. It had overheated from low water and most of the tubes needed renewing. Boiler had flanged heads with 2-in. diameter tubes, about 60-in. long. The shell was set on a firebrick foundation.

When we started removing the old tubes and putting in new ones, we found the lower tube sheet was soft from overheating. Then, as we expanded the new tube ends into the lower tube sheet, the tube expander enlarged the sheet so easily that it was almost impossible to get the tubes tight.

Being the helper, Malone said to me, "You go over to the boss' stable and get a bucket of horse droppings. That'll keep this old kettle from leaking, at least until the boss collects his money."

So I collected the "chewed hay" as we called it, and started dumping it into the boiler shell through the manhole.

Just then the boss came along and said to Malone, "For Gosh sake, man, what you putting that horse manure into my boiler for?"

Malone looked him straight in the face and answered without batting an eye, "I thought every one knew that's the way you get full horsepower from a boiler."

Well, the boiler passed inspection without leaking. And the boss got his money. What would *you* have done?

E WILLIAMS, *New Haven, Conn.*

What ruptured the tubes?

As an insurance inspector I called on a theatre that had a large CO_2 condenser in their air-conditioning system. When the system was shut down that fall, the cooling water in the condenser tubes was not blown out. The tubes must have had a slight sag because that winter the water froze, rupturing them. Keep this in mind when laying up your machinery for the winter.

J MCDONNELL, *Marshfield, Mass.*

Work inspection mirror

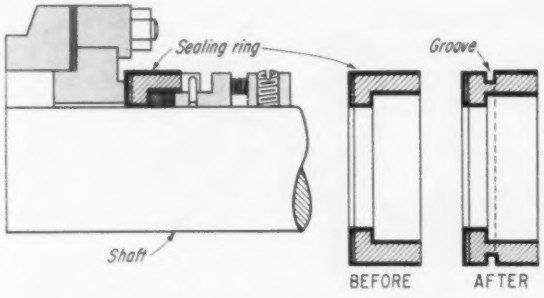
An inspection mirror comes in handy when doing repair or assembly work at home or in the shop. Next time you need one, try using an old vanity compact. They come in various sizes and shapes and have a mirror inside the cover. When closed, the compact offers protection to the mirror from breakage, scratches and smudges. Keep it in your tool box, ready for instant use. You'll find it real helpful.

F LETTINO, *Long Island City, N. Y.*

Turn page for more Practical Ideas ►

More **practical ideas**

Begins on page 118



Now, groove in sealing ring prevents seal distortion

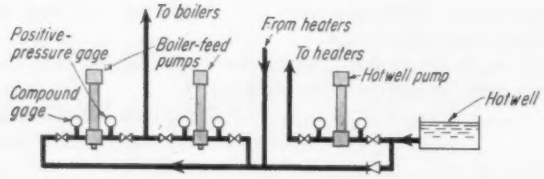
Persistent leaking of outside type mechanical seals on our centrifugal pumps forced us to give careful attention to details. These machines pump hot phenol.

We realized that under operating-temperature condition, the unsymmetric radial cross section of the metallic sealing rings caused nonuniform heat conduction from the sealing-ring face, see sketch.

This nonuniform heat conduction, with the resulting unequal thermal expansion, distorted the sealing-ring face enough for the seals to leak. To stop this trouble, an annular groove was machined in the sealing ring. Result: A symmetric radial cross section that gives uniform heat conduction from the sealing-ring face and, thereby, prevents unequal thermal expansion with its attendant distortion. Our seals now do the job they are supposed to do.

E WITTMANN, *Villan, N. J.*

ATTENTION: Mechanical-seal manufacturers, please take note.—*Editor*

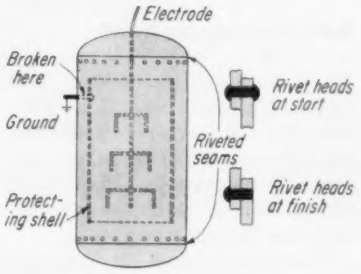


Feed pumps need not get airbound if gaged like this

In POWER, April 1958, p 134, J DeHaas describes a pump problem: Reciprocating feedwater pumps take suction from a direct contact heater or a hotwell. The dc heater is 40 ft above the pumps, providing positive suction at all times. Hotwell is at the same level as the pumps. When drawing from the latter, the pump would not take suction. Accidentally, DeHaas noticed a plug in the pump suction cylinder had dropped out, allowing air to enter the suction.

To avoid problems like this, I recommend that pressure gages be installed in the suction and discharge sides of all pumps. Sketch is an elementary diagram showing details. Observation of these instruments tells the operator if the required pressure exists. If gages had been installed during hotwell operation, DeHaas would have noticed the suction pressure was about atmospheric, indicating an air leak. With an airtight system, a negative pressure would be indicated by the compound gage.

H B WAYNE, *Woodhaven, N. Y.*



Don't let this happen . . .

Some years back, we installed the first electric steam generator in a paper mill. The unit ran so well that we gave her the full steam load.

One night the operator called me, claiming that the rivets in the electric steam generator were red hot. I got down to the mill in a hurry. Looking around, I could find no red hot rivets, and began wondering what condition my operator and firemen were in.

Just about then the fireman ran into the engine room, yelling that a rivet was red. I hurried inside. Sure enough, a rivet on the bottom circumferential seam was glowing a bright red. Then, as we watched, it blackened and in a few minutes another rivet began to glow. This business of one rivet after another glowing kept up. So, as soon as we got a dozen coal burners lit off, I took the electric steam generator off the line.

The trouble? We found a broken ground from the protecting shell, sketch. Current was moving to the ground through the rivets that were nearest to the protecting shell. When enough metal had burned off one rivet, the arc went to the next rivet. We found all rivet heads cut off flush with the shell, as neat as any mechanic could have done with a grinding wheel. Don't let it happen to you!

W GEDDES, *Montreal, Que.*

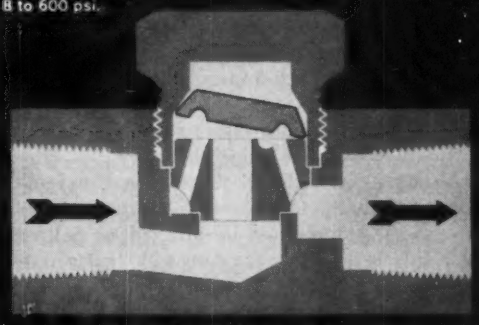
My biggest boner

Please turn to page 158

NEW YARWAY IMPULSE* STEAM TRAP ENGINEERED FOR YOUR LIGHT LOAD REQUIREMENTS

YARWAY NO. 30

Actual size new Yarway No. 30 (½" size). For all pressures 8 to 600 psi.



Cross-section Yarway No. 30 shows lever valve in open position.

- **Economy of operation on light loads**
  - **Closer shut-off**
  - **Quieter operation due to lever action**
- **Economy of Maintenance**
  - **Replaceable valve-seat assembly**
  - **One moving part**
  - **Stainless steel construction**

Put this trap on tracer lines, steam line drips and other light load applications. Order from your local Yarway distributor.

For free bulletin, write Yarnall-Waring Company, 100 Mermaid Ave., Philadelphia 18, Pa.

*IMPULSE . . . A COMPLETE LINE OF STEAM TRAPS, OPERATING ON A PROVEN THERMODYNAMIC PRINCIPLE.

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NORMAL NEEDS Famous Series 60 Impulse traps (pressures to 400 psi) and Series 120 (pressures to 600 psi) meet most normal needs

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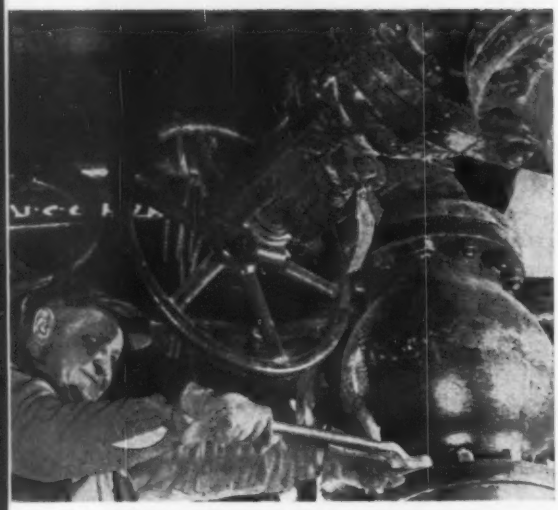
POWER PLANT AND MARINE SERVICE Yarway Integral Strainer Traps fill the bill for marine and high pressure power plant jobs

These **plant problems** could well be yours...

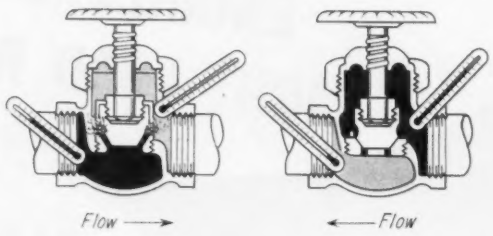


The problem

What's the best way to install globe valves?

As plant engineer it's always been my practice to install globe valves with incoming flow putting pressure on bottom of the valve seat. But in our recent plant expansion all globe valves were arranged so that incoming flow is on top of the seat. At this point I'm a little confused. Did our contractor make a mistake? Does the direction of flow make any real difference? Will it have any effect on valve operation and maintenance? What is the best way to hook up globe valves? I'd like to hear how others have handled this.—*EPH, June* POWER

The solutions



Pressure under disk may unseat valve

Globe valve, left, has pressure under disk. Cooling of stem at shutoff may cause enough contraction to unseat the valve, causing leakage. We use this hookup for throttling service in our plant. Globe valve, right, has the higher pressure and temperature above the disk. We use this arrangement for block valves since it helps insure tight seating. On lines where continuous flow is needed, it's safer to have pressure below disk. Valve will then fail in open position.

E H ANDERSON, *Belgium*

Application fixes direction of flow

Direction of flow in a globe valve depends on (1) fluid temperature and pressure (2) need for fail-safe equipment protection (3) type of disk material and (4) merits of easy opening or closing.

With high-temperature and pressure steam it's usually correct to have inlet pressure above the valve disk. Resulting force keeps disk tight on the seat and prevents leakage. But if inability to open a valve can damage equipment, incoming flow must be directed to bottom of the disk. This is definitely the case with boiler-feedwater lines.

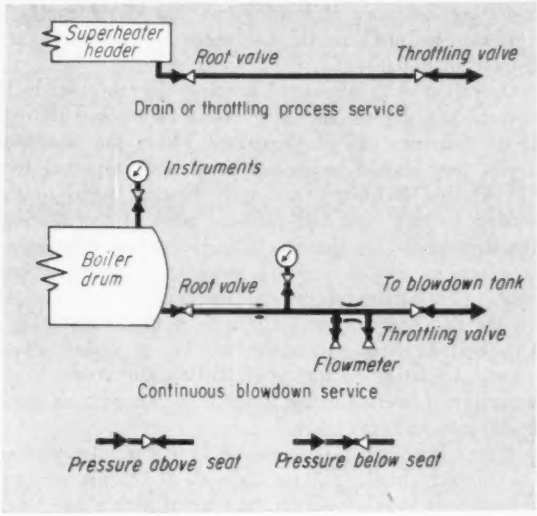
Composition type disk gives longer life when inlet flow is directed against the bottom. Leakage usually isn't a problem since this disk seats readily at the relatively low temperatures and pressures on which it's used. Composition disks aren't suited for throttling service because the disk will swell. The valve will then have a poor seat resulting in leakage and a greatly shortened service life.

Finally, if the factors above are unimportant, select the direction of flow which gives easier valve opening or closing. Incoming flow under the seat helps to open the valve. Reversing the flow will make it easier to shut.

H B MINICK JR, *Atlanta, Ga.*

...Here's how *Power* readers would tackle them

ROBERT MARKS, Assistant Editor



These hookups reduce globe valve wear

Our tests on small globe valves (2 in. and below) in throttling services at 600 to 2500 psi show reduced seat and disk wear when incoming flow enters above the valve seat. So we adopted the valve installation method diagrammed above for this service.

Conventional way to install globe valves is with flow under the seat. Valve can be closed against pressure to permit repacking (provided the seat is tight) without further isolating the upstream pressure source. This also insures continued flow in case valve seat and stem come apart. ASME *Boiler Code* calls for globe-valve installation with pressure under the seat in boiler-feedwater lines.

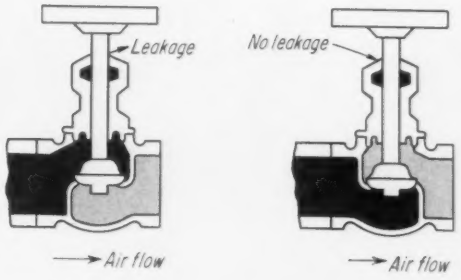
If pressure drop is important, consider straight-way globe valves, or angle valves which inherently have less pressure drop than globe valves.

E J SIEGEL, *Elizabeth, N. J.*

Valve repacking is important factor

Chemical-process industry uses many rising stem, plug-type seat, globe and Y-pattern valves. Action of chemicals on valve packing has always been a problem. Repacking with minimum hazard means installing valves with incoming flow on bottom of plug. Valve is seated against flow, releasing pressure on top of plug. Packing can then be replaced since there isn't any internal pressure below it.

K N BANTHIN, *Broadview, Ill.*



Run compressed air in below seat

Our globe valves are on compressed-air storage tanks feeding compressed-air circuit-breaker equipment. We apply pressure to bottom of valve seat for two main reasons. First, if pressure is applied to top of seat, above left, air may continuously leak around the stem. Packing on many valves is seldom satisfactory in this respect. But if pressure is below the seat, packing is off duty as long as the valve is closed. Second, it's easier to control the very low air flows used for this service.

H MEIER, *Los Angeles, Calif.*

Here's a roundup of the pros and cons

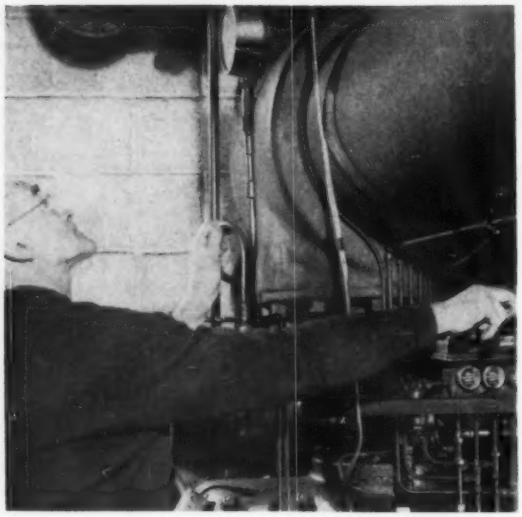
Installing a globe valve with upstream pressures under the seat has several advantages: (1) Less pressure is needed to open it. (2) If valve isn't backseating, stem packing can be replaced after closing the valve. (3) If flow is controlled, better regulation is possible. (4) If valve head breaks off stem, flow will continue. (5) If major job is shutoff and the valve is usually closed, packing leakage is prevented. This is most important with gases. (6) If valve seat disk washer becomes loose, there is less likelihood of dropping the washer on the seat to stop flow.

With upstream pressure on top of seat (1) less pressure is needed for tight seating and (2) valve seat and the stem packing are less likely to dry out.

If valve is closed only in emergencies, direction of flow makes little difference, especially if stem is backseating for repacking under pressure. But I believe there are enough advantages to recommend upstream pressure under the seat in most cases.

S R HIRSCH, *Harrison, N. J.*

Turn page for new problems ▶



The problem

What can we do about hot bearings on our air compressors?

I'm shift engineer for a manufacturing plant that uses quite a few large air compressors. The oldest machine was installed about ten years ago and the others are almost the same vintage. Lately, we've had a lot of trouble with hot compressor bearings and haven't been able to come up with a solution. Every time this happens we slow the unit down and flood the bearings with oil to reduce temperature. But we still don't know when it's safe to stop it entirely. So far none of the bearings have seized. Is there a rule of thumb we can use as a guide? Will new bearings in another material solve our problem? What other factors are important in the overall picture? These are only some of the questions running through my mind. Any suggestions will be appreciated.—*JV, June* POWER

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them

The solutions

Inspect bearings carefully for damage

Make sure that oil of the correct specification, determined by a competent lubrication engineer, is used and replaced at least after every 1000 hours of operation. Then check operating clearance of bearings so that an adequate oil film can be maintained. Clearance will usually vary from 0.002 to 0.004 in.

Operation with abnormal bearing clearance tends to squeeze out the oil and may result in cracked linings. If the bearings can't be operated within the clearance limits, they should be disassembled and inspected for: (1) **Pulled babbitt**—caused by heating metal to the boiling point in the high-pressure zone of the bearing. It's then pulled by the revolving journal and deposited in clearance spaces and oil ways in the low-pressure zone. (2) **Knife edges**—the presence of sharp edges on the box that scrape oil film from the journal. (3) **Cracked or broken linings** tending to siphon all or a part of existing oil film. (4) **Riding the iron**—wearing away of bearing lining to the point where hard-metal backing contacts the journal.

Pulled babbitt can be removed by a carefully wielded thin-bladed chisel. Follow up with a bearing scraper. Smooth any rough spots on the journal with a fine hone. Then chamfer all edges of boxes and bearings. Anchor cracked or slightly broken bearing linings with soft-copper dowels. If bearings are worn down to backing metal, replacement or relining is a must.

On continuously operated machines, it is highly desirable to stock replacements for all vulnerable bearings. Then if replacements are needed, operation is assured while the defective bearing is repaired or relined.

If *JV's* bearings are intact and lined with any of the many good grades of soft bearing metal, he will gain nothing by changing to another type. No bearing will operate long on metal-to-metal contact without burning up. The proper oil film must be established promptly. So the key to trouble-free operation depends entirely on adequate lubrication.

M A JENSEN, *Lincoln, Neb.*

Foundation shift may be the culprit

If all *JV's* machines started giving trouble at the same time, a foundation shift may be the cause. Compressors on a common floor which is overloaded may yield enough to put all the bearings out of line. This happens when a floor slab, stiff enough for one or two machines, is loaded up with others over the years. Steel-frame floors will also yield under increased load and pull bearings out of alignment. If only the older machines are heating up the cause may be (1) a builtup crank twisted slightly out of line (2) uneven bearing wear causing misalignment (3) oil left in crankcase too long, which has deteriorated so that it's no longer doing a lubricating job.

P D HOBSON, *Concord, Calif.*

Cooling-water lines may be plugged

Since *JV's* machines are about ten years old, they are probably water cooled. If this is the case, cooling-water lines may be corroded. Give them a thorough cleaning to make sure that flow isn't restricted.

Improper cooling can increase load on the driver, causing compressor cylinders to overheat. This extra load may make bearings hotter than normal.

S R HIGGENS, *Long Beach, Calif.*

Compressors are probably overloaded

If *JV* will checks these points I'm sure he'll find the reason for his hot bearings. Even a ten-year-old compressor will give trouble-free service when properly maintained. (1) See if compressor is running faster than its design speed. Older installations are often speeded up to get increased capacity. Slowing the machine down will help considerably. (2) Check the kind of lubricant used. Low-grade oils may break down under full load and high speed. (3) Measure clearance between piston and cylinder heads and compare it with manufacturer's specification. (4) See that bearings are lined up properly and have the right amount of clearance. (5) Inspect the bearings to make sure that they fit properly and do not have any high spots.

A C VEEN, *New York, N. Y.*

Here's a four-point inspection guide

JV needs a preventive maintenance program, inspection and repair procedures to correct his compressor troubles and continue operation at peak efficiency.

First step is to look up the original purchase specifications, service manuals and drawings and really become acquainted with the equipment. Then make a careful log of all troubles. Include temperature readings on the bearing housing. Flush and examine the bearings for signs of oil contamination. Then arrange for a shutdown and inspection of one unit. Be sure to have bearing replacements on hand in case they are needed.

(1) Inspect the main crankshaft bearing for tight races, correct end play and condition of oil retainers and bearings. (2) Check clearance of crank bearing, condition of surface, amount of side play and clearance in oil grooves and ports. (3) Inspect the cross-head slides for clearance and the cross head for scoring. (4) Finally, run a similar check on the valves, cylinder ring, and the rest of the compressor. Of course there isn't any need to change bearing material until inspection has pinned down the trouble.

For efficient operation of any compressor and maximum return on investment, a preventive-maintenance program is well worth the time and money.

K N BANTHIN, *Broadview, Ill.*

Call on lubrication engineer for help

Selection of a bearing lubricant depends upon compressor size and speed as well as lubricating-system design. Three main systems are in general use. Splash type dips part of running gear into the oil. Flood type uses a pump to circulate lubricant and flood the bearings. Pressure type pumps oil into bearings under pressure.

Physical condition of the compressor certainly affects performance. Bearings with insufficient oil clearances limit entry of heavy oil into the wearing area. Resulting lack of lubricant causes overheating and, ultimately, seizing. Compressor construction, operating pressure, speed and type of lubrication system all vary widely. So contact both the manufacturer's field engineer and the oil company's lubrication specialist for help.

H B WAYNE, *Woodhaven, N. Y.*

——Your September problems——

How can we track down source of motor-generator trouble?

We're having problems with our m-g set consisting of a 125 hp synchronous motor coupled to a 98.5 kva cycle generator. Five bearings costing about $100 each have been ruined. Each time the set is down for bearing replacement, equipment in the plant is nonproductive and employees are idle. If this keeps up we may have a bottleneck on our hands that will stop production in the entire plant. We have noticed an unusual sound coming from the generator which has been getting louder. How can we track down the source of trouble and stop it? What experience have other POWER readers had that may shed some light on this situation?—*FTR*

What tank materials are best for storing demineralized water?

Our plant-expansion plans include installation of a demineralizing plant for process water and boiler feed. Treated-water storage needs haven't been definitely established yet, but it looks as if we can use about 100,000 gal. Effluent of the demineralizing plant will have less than one ppm total dissolved solids at a pH of about eight. What tank materials and linings are best for this service? How do they compare costwise? Can we get by with ordinary carbon steel? How about aluminum? I'd like to know what experience other POWER readers have had with these various materials of construction.—*SJM*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Your page for **comment**

BOB BELLAS, Assistant Editor

Out of this world

I enjoyed reading Mr Skrotzki's article ("POWER for space," April 1958, p 84).

With the advent of our expanded interest in space research, more articles of this kind are needed to prepare the general public for a better understanding of the problems involved. I thought his presentation was excellent and couched in terms a "non space man" could understand.

J P HAGEN, *Director*
Project VANGUARD
U.S. Naval Research Laboratory

. . . a thoroughly understandable and enjoyable discussion of what these rocket jockeys are up to. My 14-year-old son, a member of his high school science group engaged in a rocketry project, has been giving me pitying glances since the first time I attempted to join one of his gang's shoptalk sessions in the basement of our home. Now I can meet them on more even terms.

PETER BUSCARDI, *Philadelphia, Pa.*

Squeeze play

The article "How i-c engines use thermal energy" (POWER, April 1958, p 98) was most interesting. However, it raises a question for which I've been seeking an answer for some time: Can you explain mathematically why two engines having identical compression *ratios* may not have identical compression *pressures* if they are of dissimilar size?

For example, an engine I have in mind has a 4⅛-in. bore, a 10.5:1 compression ratio, and develops 168-psi compression pressure. A larger engine of 9⅜-in. bore and a 6.75:1 compression ratio develops 198-psi compression pressure.

This phenomenon was early noted by a carburetor company when they observed that a fuel of suitable octane requirement for a small displacement engine would cause severe detonation in a large engine, even when the large engine's compression ratio was less than the small engine's.

Differences in valve timing, bore-stroke ratio, etc, doubtless have a bearing in this matter. But the essential fact emerges that size alone has a substantial effect, and I'm unable to rationalize this concept. Is there a simple answer?

DAN HAACK, *Tulsa, Okla.*

EDITOR'S NOTE: *Thermal energy pundit Skrotzki explains such goings-on as follows:*

. . . This situation has been generally recognized by engine builders, but I haven't run across any published explanation. However, I believe there is a relatively simple one.

From the simple pressure-volume relation for compression in a cylinder $P_1V_1^n = P_2V_2^n$ we get the relation between compression ratio and pressure ratio, $V_r^n = P_r$. The relation between the two ratios depends entirely upon the value of n. For a constant-temperature compression $n = 1$; for an isentropic compression $n = k$. For the first type all the work done on the gas is immediately transferred as heat to the cooling-jacket water; for the second type all the compression work goes to raise the internal energy of the gas and since n is greater than 1, P_r will be higher.

Now, let's turn our attention to the relation between the surface and volume of a cylinder; for simplicity we'll assume it is the same as for a cube. Volume V of cube is proportional to the cube of its edge length, D^3 and its surface S is proportional to the square of the edge, D^2. Then, the ratio of surface to volume is $S/V = D^2/D^3 = 1/D$. This means that as the cylinder grows larger, the ratio S/V grows smaller, or a large cylinder has less surface per unit volume than a small cylinder.

We can conclude from this that a larger cylinder has less heat-transfer surface per unit volume. Then, on a unit basis it can transfer less heat to the jacket water and so its compression process will have a higher n, giving a higher pressure ratio for a given compression ratio.

Doggone that printer

This comes to you in an effort to save you from yourself. Back in 1957, you used the phrase "Ac current" ("Can soils rectify ac current, cause corrosion?" POWER, April 1957, p 140). I beat back an impulse to write; everyone's entitled to a slip and speak of "alternating-current current," I thought.

Many publications blithely print such phrases as "cancel out," "separate out," "filter out," and I don't turn a hair. I don't know and care less as to why they insist on adding "out" to these plainly understandable verbs. But I'd have bet that my favorite technical magazine (guess who?) wouldn't use 'em. But on page 134 of your August issue ("Here's what additives did at our plant"—*Plant Problems*) you said "settle out." And don't blame it on W J Steinert. I know you edit everything.

F B M THOMPSON, *Toronto, Can.*

PLAN '59 *Modernize now for growth and profits*

POWER's Plant Design Issue, coming next month, will be our contribution to the *McGraw-Hill PLAN '59* editorial program aimed to show how industry and all America can benefit by modernization of plant and equipment. Watch for it!

(Advertisement)

Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8129 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

801ST

How Different Condensing Rates Can Slow Production

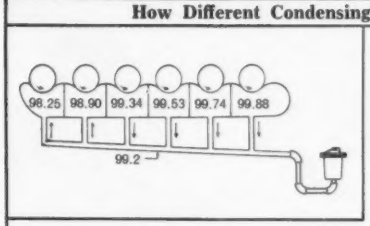


Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

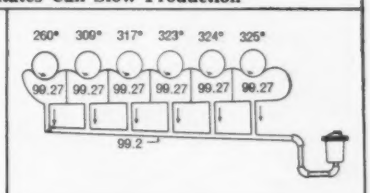


Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

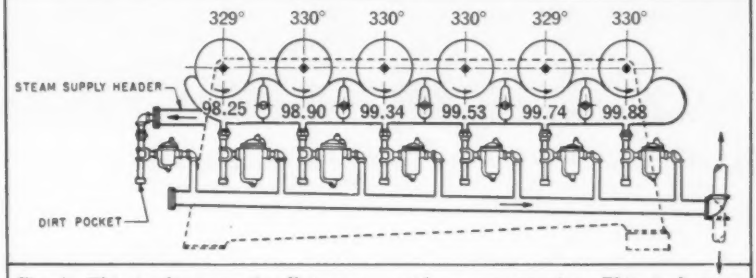
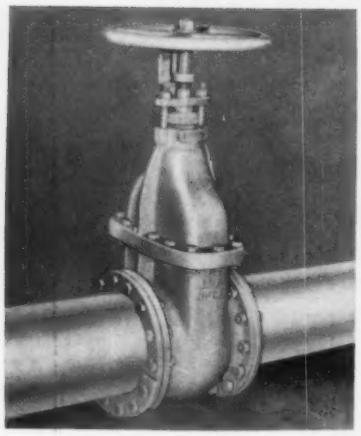
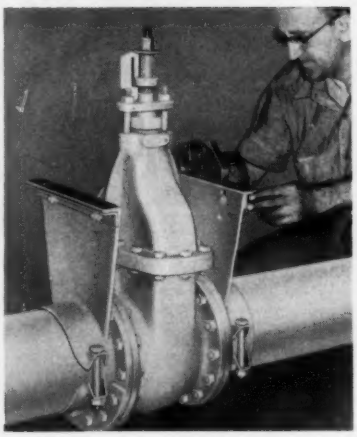


Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

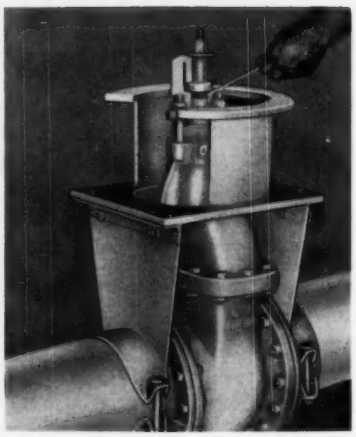
ARMSTRONG STEAM TRAPS



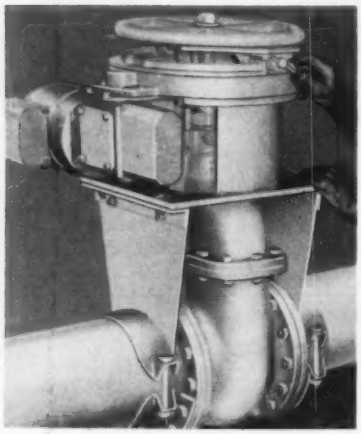
1 Here's an old 8-in. hand-operated gate valve that can be motorized easily



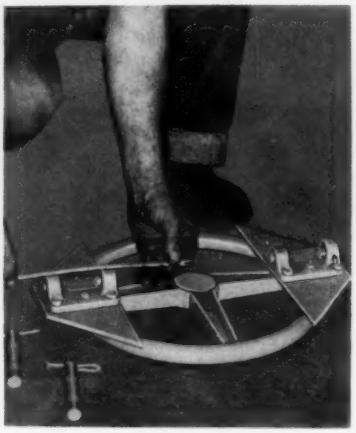
2 Mount adapter brackets. Check to see if both brackets are level and parallel



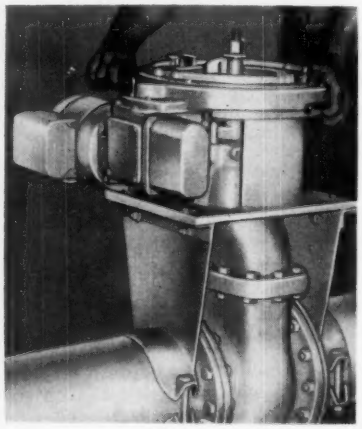
3 Bolt top adapter to brackets; adapter and valve stem must be concentric



4 When everything is in line, bolt actuating mechanism to the top adapter



5 Bolt drive pin brackets to valve handwheel; they must be centered, in line



6 Insert self-locking drive pins, then install the remote electrical controls

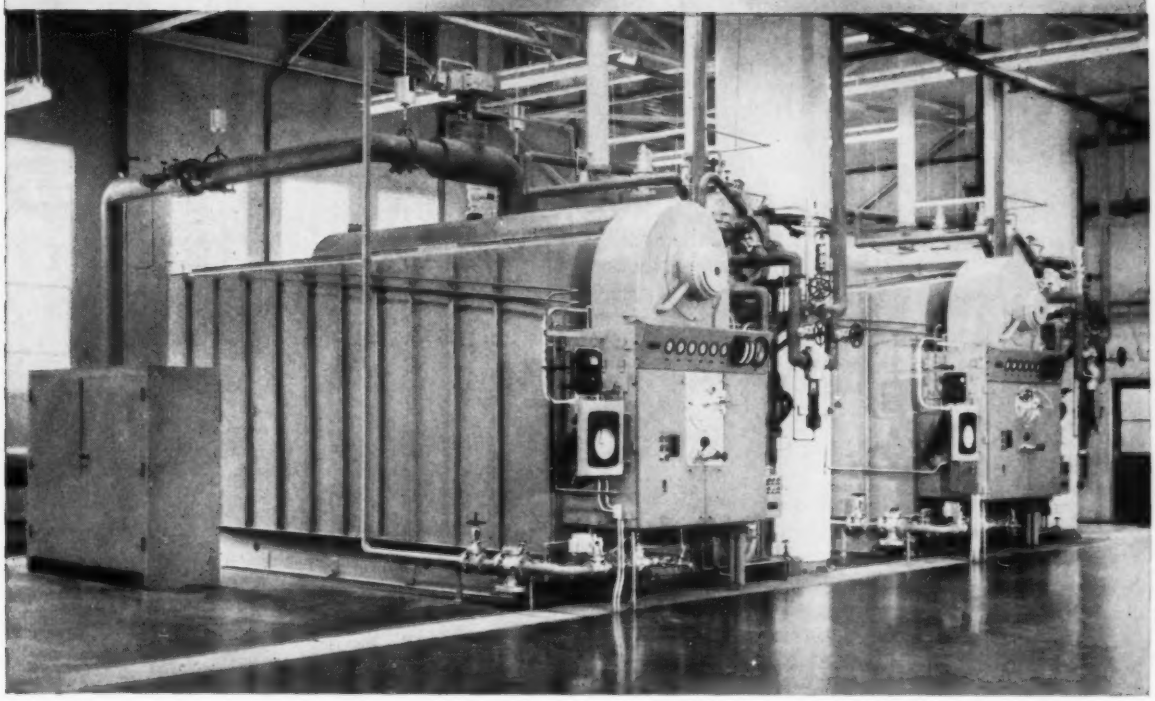
How to motorize valves

Now, you can change installed valves from hand-operation to electric-motor operation with a simple conversion unit. Job can be done without special engineering skills and without disturbing piping or replacing existing valves.

Ordinary plant tools are used to convert the average valve in six easy steps, see photos. Only requirements are that the valve handle doesn't rise and is free to rotate when the valve is operating under power. In case of power failure, the pushbutton-operated valve can be restored to manual operation by simply removing two pins.

Position and torque limits are provided in both directions of rotation to prevent injury to the valve. Unit shown can be moved from one valve to another; no special wiring is needed.—*Courtesy, C H Wheeler Manufacturing Co*

PACKAGED STEAM
by Foster Wheeler
at BOEING DEVELOPMENT CENTER



Two 34,000 lb/hr Packaged Steam Generators supply heating and process load at aircraft and missile research center

In the boiler room at Boeing Aircraft Company's new development center in Seattle, Washington, the two Foster Wheeler AG-134 Packaged Steam Generators shown above provide ample capacity for both present and future loads.

Each unit has a guaranteed rating of 34,000 lb/hr at 250 lb design pressure and 150 lb working pressure with oil firing. When firing natural gas, the output is 32,000 lb/hr.

Shipped completely assembled from Foster Wheeler's Dansville, N. Y. plant, they were installed on simple slab foundations. Each unit is equipped with semi-automatic combustion controls and a 44-inch self-supporting stack. The 36-inch steam drum includes a baffled steam collector, piping for feedwater distribution, continuous and surface blowoff. Staggered boiler bank tubes and closely spaced waterwall tubes contribute to high efficiency while large furnace volume provides conservative rates of heat liberation.

FW Packaged Steam Generators are now available in capacities from 10,000 to more than 60,000 pounds per hour. For complete information, write to *Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.*

FOSTER WHEELER

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"I'll tell you guys how I helped get the low bid on a dredging job, and all I did was put the tide to work," boasted Marmaduke

Marmy's low bridge

Eleven years is a long time to travel after an old character just to jot down all the unusual engineering problems he claims to have solved. It's especially long when the cantankerous gent happens to be Marmaduke Surfaceblow who never gives a direct answer to your questions.

And, as you readers know, Marmy's just about covered all bases—from raising a ship's mast with the aid of two cobras, to solving a refrigeration problem by putting a horse in a church steeple. As far as I know, all his stories are true. I'm sure they all happened, or at least *could* have happened.

When I dropped into his hangout, the Bent Propeller Bar, this morning and learned he was busy at his office on a big deal, I scooted right over. Climbing the rickety stairs to his office on the second floor of O'Houlihan's Machine Shop & Engine Works, I heard his foghorn voice barking into his telephone. Then, stepping into the smoke-filled room, I saw the usual waterfront characters holding down the ship's settee. The boys were slurping coffee and wrangling, all talking at the same time.

Marmy's roll-top desk was covered with blueprints. I gathered from the conversation that they were drawings of the big 2-stage horizontal ammonia compressor at Lowey's Brewery around the corner. Evidently the frame had cracked from a slug of liquid ammonia and Marmy had been called in to help get the machine rolling in a hurry.

Soon as Marmy hung up, I asked how he expected to resurrect that beat-up piece of equipment.

"BILGEWATER on repairing ice machines!" he roared, in his foghorn voice. "I'll tell you guys how I helped get the low bid on a dredging job, and all I did was put the tide to work." That did it. There wasn't a squawk out of anyone as Marmy hoisted his size-16 canal boats up on his roll-top desk, leaned back in his swivel chair, and started sounding off.

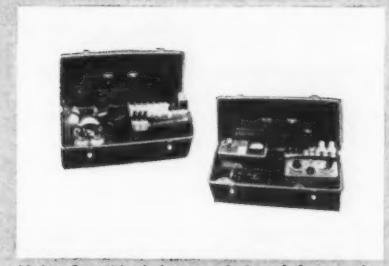
"Back in the summer of 1934, I worked as outside machinist at a San Francisco shipyard," he roared. "One Sunday I drove down to the bay to see an ex-shipmate who had inherited a dredging business several years before. Frank Smigoski was his name. The two of us had seen the world years before by shoveling tons of coal into the boilers of the old battleship *USS Portland*.

"I found Frank in his office down on the pier. We drove over to a roadhouse for lunch, and Frank told me about a (*Continued on page* 154)

NALCO BRINGS THE LABORATORY TO YOU...

Walking water lab.—a Nalco Representative can make a tremendous number of on-the-spot tests with equipment he always has with him.

Accurate, complete in-plant Nalco tests close the gap between water problem diagnosis and successful treatment.



Nalco Portable Labs are designed for use by Nalco people, whose testing problems range across the entire field of water treatment.

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ALKALINITIES / CHLORIDES / HARDNESS / PHOSPHATE (ORTHO & POLY) / DISSOLVED SOLIDS / IRON
OXYGEN / pH / ALUMINA / SILICA / CHROMATE / SULFITE / SULFATE / COAGULATION / FREE CO_2

Most water treatment problems you are likely to encounter can be solved right in your plant—thanks to Nalco's unique portable laboratories, used by your highly mobile Nalco Representative. And, of course, he has all the facilities of the Nalco main laboratories to call on for special analyses—suspended solids, manganese, or even radio activity.

Putting the facilities and skills of the world's largest water treatment organization right in your plant saves valuable time, speeds putting effective water treatment to work, and gives quick answers to meet changing water or operating conditions.

Right now is the best time to get an expert appraisal of your water treatment by your Nalco Representative. Call or write today.

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THE *Nalco*® SYSTEM...

SERVING WORLD INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE

Reports from the field

What's happening in power and what it means to you

Fuel contracts awarded for Fermi "breeder" plant

Initial fuel loadings for the Enrico Fermi atomic power plant will be produced by Sylvania-Corning Nuclear Corp and by a team made up of Nuclear Metals, Inc and the D E Makepeace Div of Englehard Industries. The two contracts, each for over $1 million, were awarded by Power Reactor Development Co, a nonprofit organization of 14 utilities and seven manufacturers currently building the reactor station at Lagoona Beach, Mich.

Fuel elements making up the core consist of small rods of uranium—nuclear technologists, above, are removing an element from a "pickling" vat. Enrico Fermi will be world's first "breeder-type" station. It will actually create more fissionable material than it consumes in its own steam-generating operation, using U-238 to produce plutonium.

Work done is expected to advance significantly the technology of economic fuel-element production, a key, in our private-enterprise economy, to industrial use of nuclear power.

(*More Reports on page* 180)

Power Lines

Russian vocabulary—enough to pick out key words and phrases—is given in ASME-AIChE conference paper *58-HT-9*. Vocabulary list lets you scan the Russian-language article, see if you want it translated.

Latest graduates from Lehigh U's engineering course started at average salaries of $474 a month. Last year the average was $465. Electrical engineering grads averaged $485, with chemical engineers getting $477 and ME's $474.

Aluminum foil can now be welded in continuous seams, opening the door to increased use of aluminum in electrical connections, Gulton Industries, Inc announces.

Atomic-radiation blocker used in Sweden's new atomic-research station at Studsvik is iron-ore concrete. Cement for the reactor pool is mixed with ore instead of stone to increase weight and radiation protection.

Gas lubrication, a 100-yr-old idea, is getting new attention from ASME member M Wildman of N American Aviation, Inc. H-p air, neon, helium etc. can be injected around a bearing. Air-lube may be used with h-t parts, radioactive atmospheres or contamination-sensitive machines.

Highest-head reaction-type turbines in the U.S., Francis hydraulic units, will be built for Mammoth Pool hydro project of Southern Calif. Edison by S Morgan Smith Co. Maximum net operating head is to be 1009 ft.

Soviet automatic-control journal, *Avtomatika i telemekhanika*, is now available from the Instrument Society of America, 313 6th Ave, Pittsburgh 22, Pa., at $30 per year.

West-German 400-kv system was supplied by Brown Boveri Co with 220,000-kva single-phase autotransformers. Units are designed to be shipped fully assembled.

Hamburger—4000 lb of it—must be kept cool in New Orleans' Giant Super Market, world's largest. Dunham Bush refrigeration units serve two meat-cooler rooms, two fish-storage rooms, and dairy, delicatessen, produce and poultry rooms. The store covers 244,000 sq ft, and uses enough electricity daily to supply a city of 10,000.

Largest electrical generating unit west of the Rockies is Southern Calif. Edison Co's new 200,000-kw Huntington Beach steam station. . . . G.E. is providing boiler feed-pump turbines rated at 10,000 hp, 6600 rpm for TVA's 500,000-kv steam turbine-generator.

High-voltage lab addition to be built in Philadelphia by General Electric Co will test switchgear products rated at 750,000 v and up.

Solar refrigerator, probably world's first, is under test at Israel Institute of Technology. A pipe links the thermostat-controlled box to a roof-mounted radiation collector. The unit can store up enough solar energy for several cloudy days.

A crash program to ease technical-manpower shortages will utilize womanpower—engineering secretaries trained to do routine scientific work. To be offered by business colleges, course covers science, math, drafting and major engineering-scientific fields.

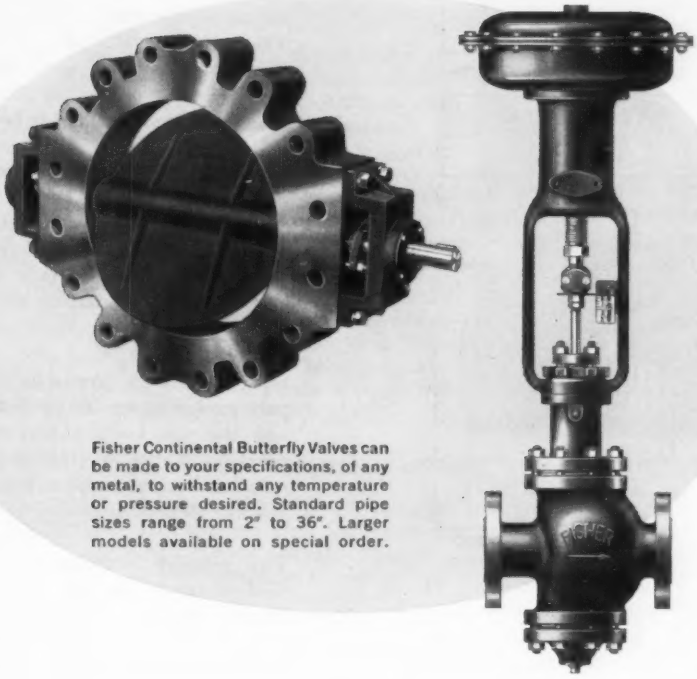
Coal rationing is off in Britain for the first time since '39. . . . American bituminous-coal industry is only 80% efficient, wastes $¼ billion a year, says economist J M Henderson in his book, *The Efficiency of the Coal Industry*.

First commercial ac electrical system, installed in a Buffalo store in 1886, was commemorated recently by the AIEE.

For Calendar of Events turn to page 184

NOW FISHER GOVERNOR
PLUS CONTINENTAL EQUIPMENT

an addition that multiplies Fisher's service to industry



Fisher Continental Butterfly Valves can be made to your specifications, of any metal, to withstand any temperature or pressure desired. Standard pipe sizes range from 2" to 36". Larger models available on special order.

With the acquisition of Continental Equipment, Fisher Governor Company is able to expand its service and product offering to its customers.

Continental Butterfly Valves are now available through the Fisher representatives listed at right.

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NEW YORK
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Badrena & Perez, Inc.

SEATTLE
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Latest engineering developments for busy power men

12 papers for you on:
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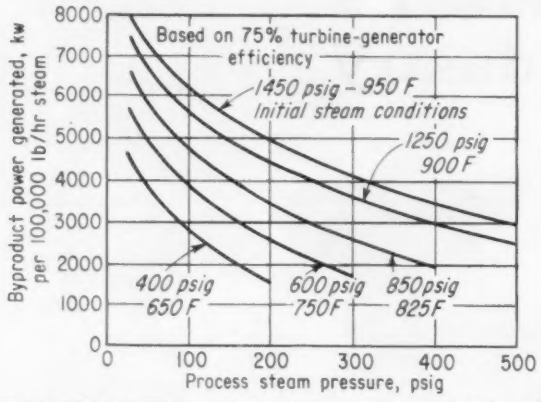
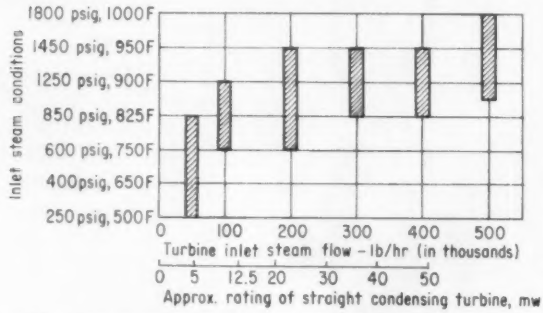


BYPRODUCT POWER available when steam is expanded through turbine from initial conditions to lower pressures for process needs



INITIAL CONDITIONS normally selected for turbines. Continuous high-load operation favors higher pressures, temperatures

Economics of power-plant operation

Short-cut methods of evaluating alternate steam and power supplies for industrial plants. *By W B Wilson and D L E Jacobs, General Electric Co*

Top management is recognizing that the steam and power supplies in their industrial plants are important factors contributing to profits and must be as carefully considered as production equipment or new process developments. Potential savings from proper selection of the steam and power cycle often go unrealized because time cannot be allocated to make detailed step-by-step performance analyses when a new plant, a modernization or an expansion is being considered.

The "short-cut" methods outlined in this paper permit quick evaluation of several alternative steam and power systems. It may be desirable to compare eight or ten different combinations of power and steam systems on a very preliminary basis. The least attractive alternatives are quickly eliminated, and engineering effort can then be directed toward detailed analyses of the promising possibilities.

For the typical industrial application of an automatic-extraction turbine used as an example in this paper, short-cut methods permit ready evaluation of alternative initial steam conditions showing how use of 1250 psig, 900 F instead of 600 psig, 750 F steam resulted in an annual fuel saving of almost $150,000 for each 10,000 kw generated. This saving is based on a fuel cost of 30 cents per million Btu, and amounts to more than 1.6 mills per kwhr.

First part of the paper reviews some general factors affecting the economics of industrial power generation — availability of byproduct power with its low Btu/kwhr chargeable to power, limitations and selection of initial steam conditions, general characteristics of the various types of turbines available. Second part includes specific performance and other data useful in making comparative studies of the alternative steam and power supplies being considered. *APC paper, no number*

The relative economics of coal and natural gas in the Baton Rouge area. *By J S Burk and H C Owen Jr, Barnard and Burk, Inc*

At present, natural gas is the predominant fuel used by industrial plants in Louisiana. However, in the last few years, the price of natural gas has increased rapidly and this trend is expected to continue.

Various Louisiana electric utility companies are investigating the use of coal at large power plants planned for the near future; some have already installed boilers that can be converted from natural gas to coal with a minimum of additional investment and downtime. Some chemical plants in the Baton Rouge area have also installed boilers of this type.

Paper presents an analysis of the more important economic factors involved. It includes an estimate of the trend of natural gas and coal prices for the next ten years and a comparison of the investment and

News and Notes on...

Good Packing Practice

JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

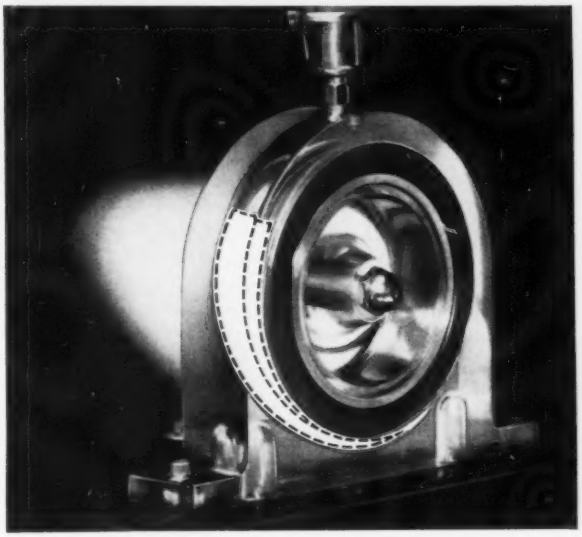
Subject of the month: Effective Shaft Sealing

Question: What is an economical way to seal in or seal out with maximum efficiency?

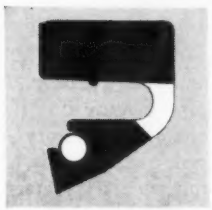
Whether the shaft bearing is of the sleeve, roller, or ball type . . . seals should meet two basic requirements: (1) provide a tight seal despite light applied pressure, and (2) resist abrasion and corrosion.

The transparent unit shown at the right was created by research engineers to study this subject of effective sealing . . . witness the performance of J-M seals in development stages. It helped them perfect the versatile, dependable line of J-M Clipper® Seals that serve many industries.

In this unit, Clipper Seals are mounted on a transparent cylinder, just as in a bearing cavity. The heel of the seal provides the rigidity essential for a press fit. The lip is flexible and soft so as to snug the shaft with a minimum of friction. Thus it acts like a gasket and effectively stops leakage.



HERE ARE JOB-TESTED RECOMMENDATIONS FOR COMMON SEALING APPLICATIONS:

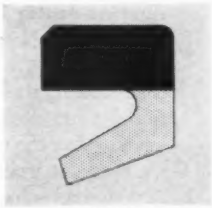


For General Service—Type LPD All Purpose. This line-contact Clipper Seal provides long life and maximum sealing effectiveness under a wide range of equipment variables. Its synthetic rubber base compound is recommended by J-M for most sealing lip applications where combined ambient and operating temperatures reach 250°F and higher. It seals practically all fluids . . . has proved highly effective against oils and greases, hot and cold water, air and many other gases and vapors. And it maintains its high efficiency despite time, high temperatures, and adverse conditions.

For Small Clearances—Split Clipper Seals. Split Clipper Seals have wide acceptance as temporary replacement seals for equipment with space or design limitations . . . to save costly downtime. Installation in inaccessible space is relatively simple and speedy. They are practically fracture-proof . . . stand up under the rough treatment . . . can be forced into position around the shaft. They give long-term, efficient sealing until a major overhaul permits replacement with solid seals.

For further data on Clipper Seals write for Book PK-71A. Address: Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

For Continuous High Speed Operations—Type LPD Metal-Reinforced. This Clipper Seal, incorporating a metal reinforcement, is ideal for use in continuous high speed and extremely abusive service such as encountered in the steel industry. It expands and contracts with the chuck in which it is installed. It is a combination of two synthetic rubber base materials that are highly resistant to cracking, hardening and shrinking.



For Small Shaft Diameters—Type SS Springless. Here's the Clipper Seal designed for smaller cavities. It is made of a selected synthetic rubber base compounded to minimize swell and deterioration in corrosive applications where chlorinated solvents, lubricating oils carrying severe additives, or similar aggressive fluids must be sealed. It is a complete part in itself—contains no metal spring. No spring is required because this seal is designed to exert sufficient lip interference on the shaft to compensate for wear over a long period of time.

JOHNS-MANVILLE

100 YEARS OF QUALITY PRODUCTS . . . 1858-1958

operating costs applying to natural gas and coal as boiler fuels.

The following are among the authors' conclusions: (1) Coal is not at present competitive with natural gas in the Baton Rouge area (or, for that matter, in the state of Louisiana) even before considering the differential in annual cost due to fixed charges, cost of coal unloading, storage, conveying and pulverizing, etc. (2) This competitive margin is gradually closing. For the next ten years, however, the margin will still be great enough to make gas the more economical fuel.

(3) After the next ten years the margin will have narrowed; the competitive situation may force the natural-gas industry to curb increases in gas prices to maintain a competitive sales position with respect to coal. *ASME paper, no number*

Economic trends affecting transportation of energy. *By S B Smith, Ebasco Services Inc*

Since World War II, there has been considerable study of the economics of transmitting energy by electricity as compared to other means. The following conclusions have come from these and more recent studies:

(1) The economic advantages of large generating units installed in stations of great capacity are so important that their use is indicated wherever load concentrations permit. (2) For meeting future load growth for many years to come, main reliance will be in steam-electric stations using coal, and lignite to a limited extent, as their primary fuel.

(3) Long-distance transmission beyond 250 to 300 miles cannot be justified economically unless the generating station is located, in effect, at mine's mouth with an assured long-term low-cost raw fuel supply. (4) The unit costs of transmitting energy electrically are lowered where large blocks of power are to be moved. Combined with high load-factor loadings, this tends to bring electric transmission and raw-fuel transportation into closer competition.

(5) Where long-distance transmission is indicated, rail competition and the financing costs of the transmission lines determine the balancing economies. (6) The use of high-debt-ratio financing by companies to provide the capital will extend the limits of economic transmission distances. *APC paper, no number*

Motors

Induction-motor temperature characteristics. *By J F Heidbreder, Westinghouse Electric Corp*

The problem of motor protection is a complicated one. Not only do motors differ from one another, but the component parts of each have different thermal time constants. These differences are largely responsible for the lack of general data on the limiting current time characteristics of large induction motors. Often the cost of large induction motors justifies tailor-making them for difficult applications. Such motors may have limited excess capacity making it difficult for relays to fully protect the motors and yet allow the normal starting duty.

Motor temperatures are limited by the temperature endurance of the insulation and mechanical stresses in the cage winding. These limitations are discussed and the resulting limiting current time characteristics given for several motors. A short method is presented for predicting motor starting performance. *AIEE paper, No. 58-761*

The dilemma of single-phase induction-motor theory. *By P L Alger, General Electric Co*

Soon after the polyphase squirrel-cage motor was developed, it was found that if one of the lines was opened after the motor was up to running speed, it would continue to operate on single-phase supply. While so operating, the stator is magnetized along the main axis only, as there is then no current in the cross axis. However, the magnetic flux in the cross axis was found to have nearly the same magnitude as that in the main axis (and to be displaced 90 deg in time phase), just as in polyphase operation.

This seemed strange, because the two axes are at right angles and therefore have no mutual inductance, so that the single-phase stator current cannot produce any magnetic flux in the cross axis. How to explain this presented a dilemma, which can be expressed by the following three questions:

(1) What are the current-flux-speed-voltage relations that explain the presence and magnitude of the cross-axis field? (2) Just how is the magnetic energy of the cross-axis field supplied and removed as the field varies throughout each cycle of the applied frequency. (3) How is the energy supplied that the torque due to the crossfield delivers to the output shaft?

This dilemma has been a topic of discussion since the turn of the century. In this paper the author presents what he thinks are the most satisfying answers, and then considers the alternative explanations that have been put forward. *AIEE paper, No. 58-939*

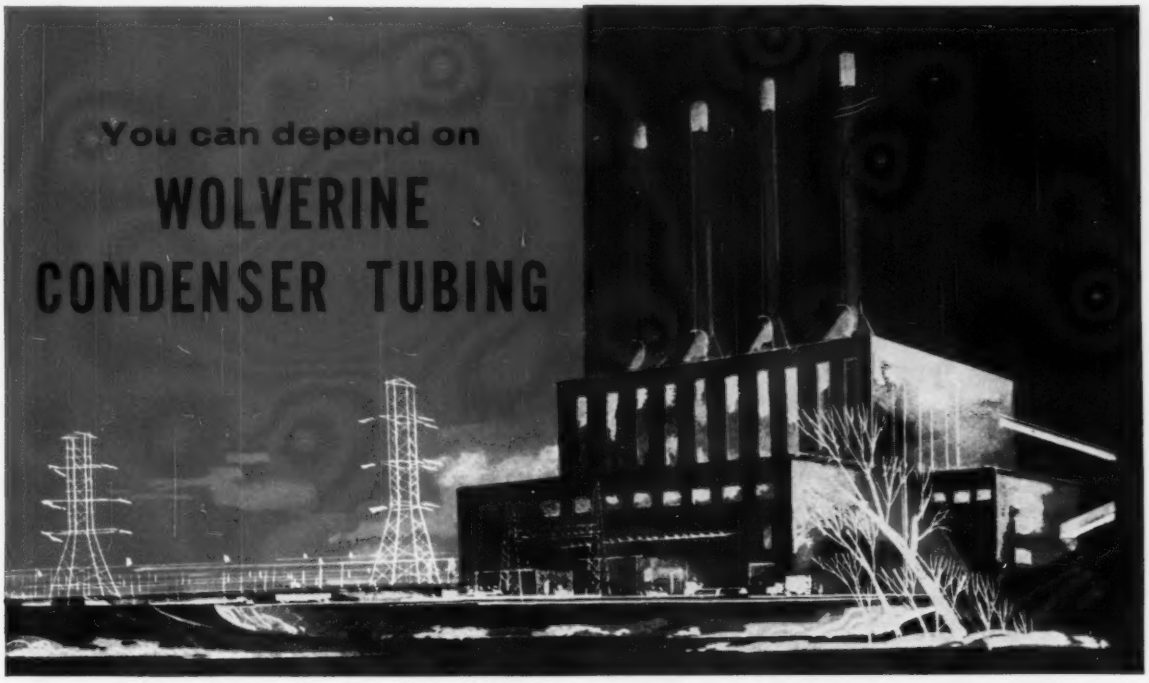
The Steinmetz conception of the single-phase squirrel-cage motor. *By E Bretch, Century Electric Co*

The double-revolving field theory of operation of single-phase motors, first proposed more than sixty years ago, has become a generally accepted concept for explaining the operation of the single-phase induction motor. Nevertheless, some engineers, including the author, have continued to question the validity of the theory.

Author states that the squirrel-cage motor was originally developed by Tesla as a polyphase motor; that is, a motor provided with a revolving primary mmf. It was later discovered that at and near synchronism it does not require a revolving primary mmf. It operates at running speed with a single-phase primary mmf as well as with a revolving one. After this discovery, there was a great deal of speculation as to how, at running speed, a single-phase mmf applied

(*Continued on page* 168)

Directions for ordering papers on page 178



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Each of these condenser tubes is backed by Wolverine Tubemanship . . . a program consisting of rigid quality control, constant research and sound engineering.

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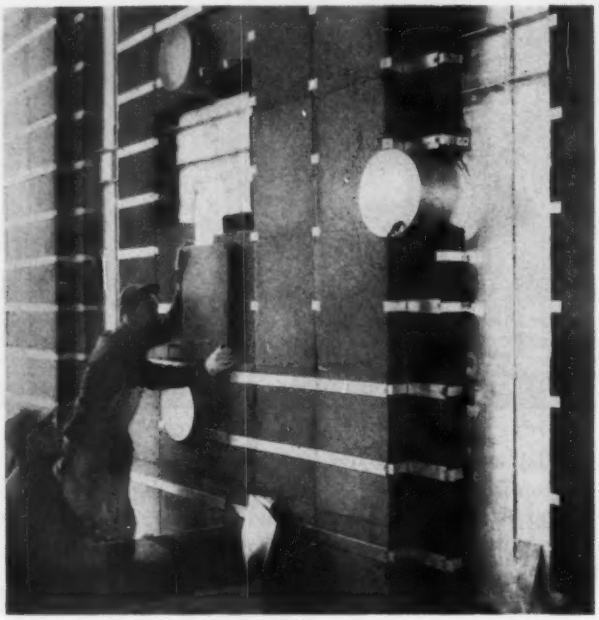
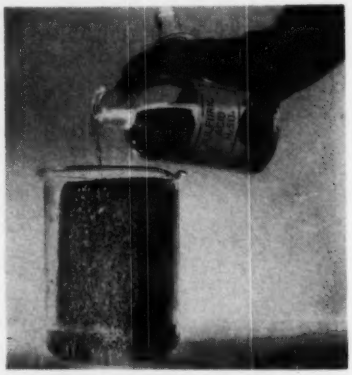


NEW INSULATION features volume stability through a range of –450 to +2200 F. It's rigid enough to take service as a load-bearing surface



ACIDS CAN'T FAZE IT. Only exceptions are hot phosphoric and hydrofluoric

OXYACETYLENE TORCH flame doesn't bother it. Water-quenched, it won't crack

Silica foams into acidproof insulation

901 • Pure molten silica, activated by a foaming agent, boils and foams into millions of tiny, noninterconnecting bubbles. When it cools, a lightweight, rigid, inorganic block results; an acid- and heat-resistant material with a wide range of applications in the chemical-process and nuclear fields and general industry.

Material, called *Foamsil*, is 99% pure fused silica. It won't oxidize or absorb moisture. Insulating value of one in. is said to equal 18 in. of acid brick at 250 F.

Temperature range is –450 to +1600 F cyclic, or to 2200 F continuous. Dimensional stability is excellent: material doesn't warp, shrink or slump during rapid temperature changes, and won't crack or spall when heated, then water-quenched.

Coefficient of expansion is low, about 1/18 that of low carbon steel, giving material volume stability throughout its operating range. It expands at temperatures up to 2200 F.

Blocks of *Foamsil* can be used as load-bearing surface to eliminate some supporting and reinforcing structure. Block sizes are 11x17 and 17x22 in., thicknesses up to 3 in. Various curved segments, fitting covers and other shapes are available.

Suggested applications include lining tanks and pipelines containing hot acids; lining concrete, brick or steel stacks subjected to corrosive atmospheres; as underground thermal insulation; in electrostatic precipitators, flues, tower packing, boiler settings.—*Pittsburgh Corning Corp, 1 Gateway Center, Pittsburgh 22, Pa.*

Foamsil at a glance

Composition: 99% silica. No absorption, capillarity or permeability. Material is incombustible.

Compressive strength is 130 to 210 lb per sq in. Resistant to all acids except hydrofluoric and hot phosphoric, but needs protection from caustics, abrasion. Density: 10 to 12 lb per cu ft.

Thermal conductivity for 11-lb density (K = Btu/sq ft/hr/deg F/in.): K = .48 at 100 F, 1.0 at 500 F, 1.85 at 900 F.

Foamsil's thermal shock resistance is excellent; temperature limits are –450 to +1600 F cyclic and –450 to +2200 F continuous. Dielectric constant relative to air is 1.35, and coefficient of expansion is 3.5×10^{-7}; pH is 7.0.

For more data on these items, use the post cards on page 151. Identify your request with item number.

Refinery Power Plant Compares Bonnet Joints

No maintenance for Crane Pressure-Seal valve on 10-year high-pressure/high-temperature service

Ten years ago two 10-inch, high-pressure-temperature gate valves were installed in the power plant of a Midwest refiner. Each one was installed on a boiler lead line, where steam service is 900° F. at 1280 psi.

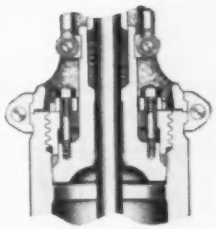
One valve is a conventional bolted bonnet type; the other, a Crane Pressure-Seal Bonnet Valve.

The bolted bonnet valve has required major maintenance four times in ten years because of bonnet joint leakage.

The Crane Pressure-Seal Bonnet Valve, during the same period, has never leaked . . . has needed no maintenance of any kind!

Conventional valves fight line pressure with heavy flanges and bolts at the bonnet joint. The bolting requires restressing and maintenance with each extreme change in temperature. Crane Pressure-Seal design harnesses line pressure to keep the bonnet joint tight despite extreme variations in temperature and pressure.

For complete information about Crane Pressure-Seal Bonnet Joint Valves—gates, globes, angles, stop-checks and swing-checks—in 600, 900, and 1500-pound classes—call your Crane Representative, or write to address below for new Circular AD-2336.



Here's the Crane Pressure-Seal Joint that eliminates bonnet joint leakage and maintenance on high-pressure-temperature services.

CRANE VALVES & FITTINGS

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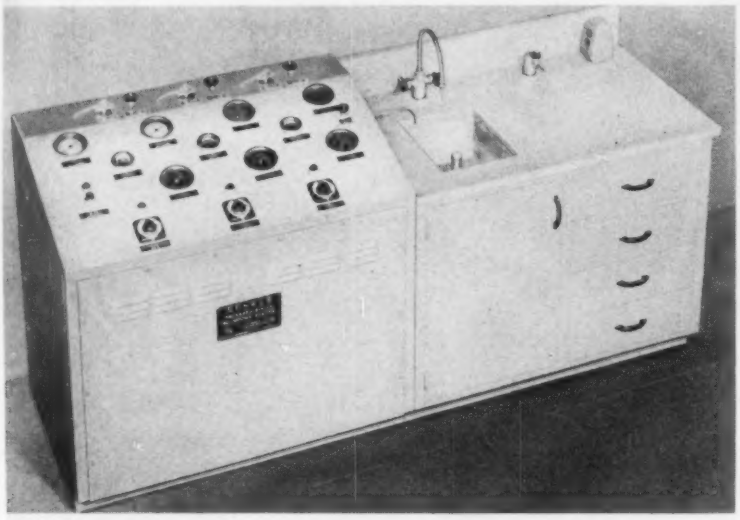
More **equipment news**



Now in one package: automatic blowdown, sampling

902 • "Total function" blowdown and sampling system combines, in a sleek console, the volume-control valves, heat exchanger and flash tank of the usual continuous-blowdown system, with all interconnecting piping, plus five special features: (1) automatic aftercooling at the drain connection (2) automatic timed pressure flush to maintain high recovery efficiency (3) complete instrumentation (4) automatic sample cooling (5) matching cabinet sink for water tests.

In addition to unique performance features, manufacturer points out that packaged design saves engineering man-hours, field-erection time and operating labor; yields compact, space-saving unit that will add to appearance of even the most eye-catching boiler room.

Special-design individual volume-control valves have forged-steel bodies with stainless-steel "knife" closure to prevent galling. Valves are unconditionally guaranteed for 10 yr. Flow rate may be reset under operating pressure with easy-to-read dial calibration. Full counterflow heat exchanger yields in excess of 80% thermal recovery on most jobs. To assure maintenance of high recovery rate, elements that normally show a gradual buildup of solids—strainer elements, flash tank, heat exchanger—are automatically pressure flushed each 8 hr. Duration of flush is adjustable from 1 to 15 sec. Air-operated flush-control valves are of "sliding-gate" design to minimize possibility of sediment accumulation.

Automatic aftercooling of sewer drains is adjustable to conform to local codes, usually set at 150 F. Aftercooler also condenses safety-valve blowoff from flash tank. High-pressure sample cooler is equipped with automatic cooling control. Illuminated individual sight-flow indicators give constant visual check; complete panel instrumentation shows all pertinent temperature, pressure and level conditions.

For testing boiler-water samples, color-matched laboratory cabinet has stainless-steel sink and nonstain nonbreakable polished top and backsplash of Johns-Manville *Colorlith*. Outlets for air and electricity are provided.

Models are available in either 250- or 600-psi designs, to handle two, three or four boilers in a single console with total capacities up to 6000 lb per hr of blowdown. Units are completely shop tested under simulated load conditions. System illustrated—4000 lb per hr, 250 psi—costs about $6000.—*Fred H Schaub Engineering Co, 2110 S Marshall Blvd, Chicago 23, Ill.*

For more data on these items, use the post cards on page 151. Identify your request with item number.

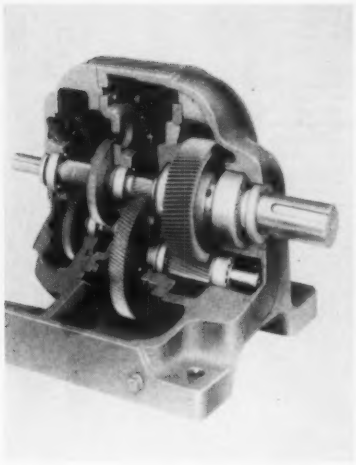
Brushless ac generators use rectifiers

903 • Brushless ac generators come in 50-, 60- and 400-cycle models They are available in single and 3-phase output in all standard commercial voltages. The revolving-field units run through 600 v, with 60-cycle 3-phase sizes extending from 5 to 400 kw; 400-cycle sizes from 1 to 250 kw. Some sizes come in 2300 or 4160 v.

There is no possibility of sparks with these brushless alternators, according to the maker. All spark-producing components have been eliminated and replaced with a system of rectifiers which changes part of the ac output to dc. The dc is fed to the field poles of the exciter, and ac output of this revolving-armature type exciter goes to a rectifier assembly which changes it to dc. The newly produced dc is then fed to the alternator's revolving-field poles.

Developmental work began in 1951, and models are said to have been successfully field-tested in hazardous environments. Units are available in single-bearing and 2-bearing close-coupled designs for direct connection to industrial engines. They can be supplied in 2-bearing design for belt-drive applications.—*Kato Engineering Co, Mankato, Minn.*

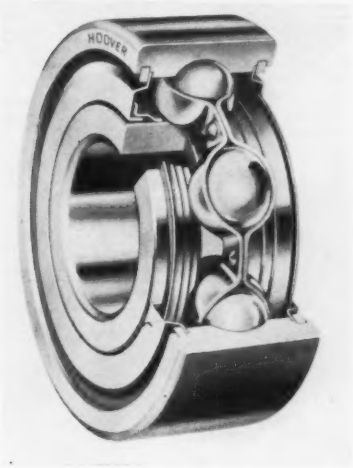
Begins on page 138



Helical gear drives boast ratios up to 2217:1

904 • Inline drives now come in quadruple reduction and larger sizes of double and triple reduction. Capacities are up to 200 hp.

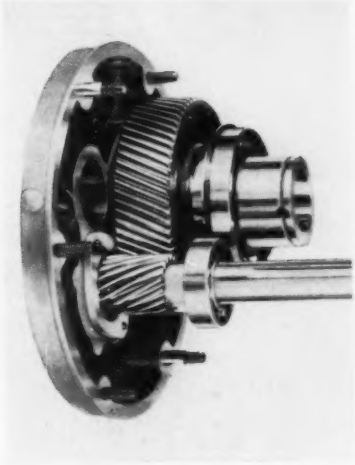
Gear arrangement consists of helical gear trains operating in high-capacity ball and roller bearings mounted in a cast-iron housing. Input and output shafts are located in the same horizontal and vertical planes. Automatic splash lubrication of all moving parts is said to insure dependable lube.—*Link-Belt Co, Prudential Plaza, Chicago 1, Ill.*



Cartridge ball bearings feature "lifetime lube"

905 • Dual labyrinth seals hold a lifetime lube supply, use slinger action to circulate it for best performance. Designed to standard double-row bearing widths, cartridge bearings are said to have extra-large reservoirs for factory-applied lube.

Seals are made up of inner and outer shields, fitted to create both a horizontal and vertical labyrinth. Running tolerances are close, so lube can't escape, dirt can't enter, according to manufacturer.—*Hoover Ball and Bearing Co, Ann Arbor, Mich.*



Speed reducers adapt to any mounting position

906 • Series features a basic unit, with either single- or double-reduction helical gearing, which can be mounted directly on the driven shaft or in standard-stock horizontal or vertical bases. Four basic sizes provide output speeds of 10 to 431 rpm, capacities of 1/6 to 15 hp.

Units are available in three types: V-belt, sprocket or gear drive to input shaft; direct motor drive to shaft; motorless to attach to customer's motor.—*Boston Gear Works, 14 Hayward St, Quincy 71, Mass.*

Clamp-on ammeter measures ac and dc

907 • Said to be the only instrument of its type to measure both ac and dc, unit comes in eight different sizes and measures up to 1000 amps.

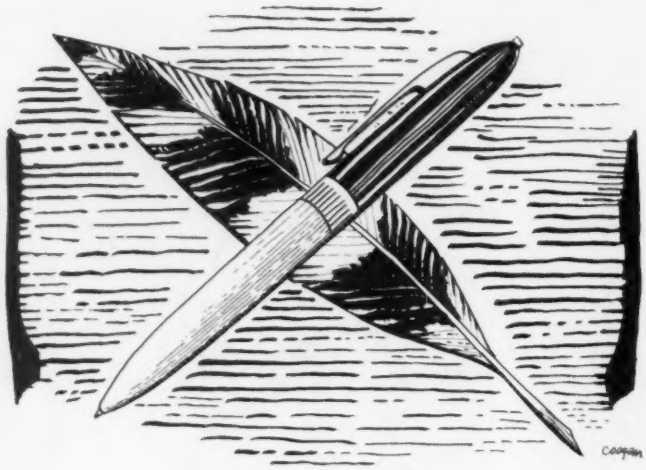
The improved ammeter has a larger damping chamber in each size range, to make readings more easily. To operate, you press the trigger and snap tongs around an electrical conductor; you don't break either circuit or insulation. Readings are instant. Unit is made without coils or windings. *Columbia Electric Mfg Co, 4519 Hamilton Ave, Cleveland, Ohio.*

Don't miss this item . . .

Crushproof insulation . . . . p 200

. . . or other product news appearing on following pages

Circuit reclosers . . . . . p 196
Self-priming pump . . . . . p 198
Diesel engine . . . . . p 206
Concrete placer . . . . . p 212
Climatized motor . . . . . p 214



George Edwards

says, "Modern living takes smart maintenance, too"

I got a chuckle out of a clipping that Wilson Edwards (no relation) sent along with a note recently. Wilson is a consulting engineer I've known for many years and one of the nice people who relay interesting tidbits for my possible use on this page.

This item seems to be aimed at folks who feel that earning a living in today's world is a tough business. It quotes instructions issued to employees by a store proprietor in 1870:

"Store will open at 7 am and close at 8 pm, except on Saturdays when it will close at 9 pm. Employees will sweep floors, dust furniture, shelves and showcases, trim wicks, fill lamps and clean chimneys. Make your pens carefully (you may whittle the quills to suit your individual taste). Open windows for fresh air. Each clerk shall bring in a bucket of water and a scuttle of coal for the day's business.

"Any employee who smokes Spanish cigars, uses liquor in any form, gets shaved at the barber shop, or frequents pool halls, will give his employer every reason to question his integrity. No matter what your income might be, you should not contribute less than $25 per year to your church.

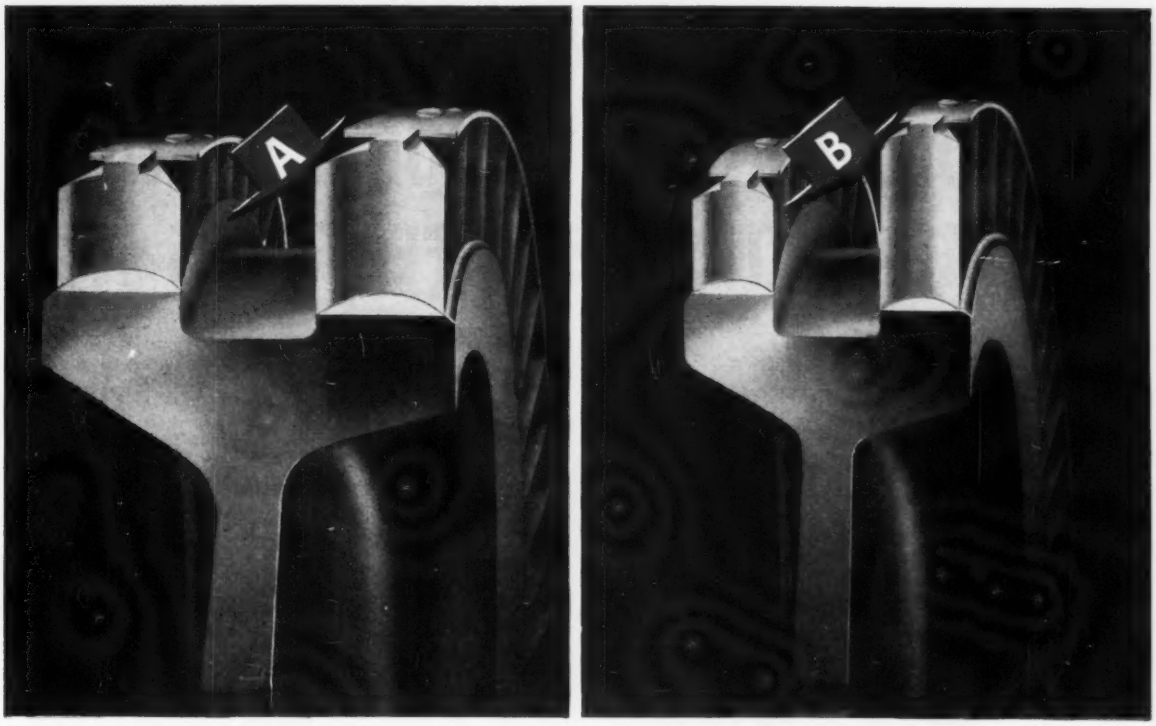
"Men employees will be given one evening off each week for courting purposes, or two evenings each week if they go regularly to church. After an employee has spent his thirteen hours of labor in the store, he should spend his leisure reading good books and contemplating the error of his ways."

Wilson's note adds, . . . "It's obvious that the people who sigh for the 'good old days' either don't remember 'em clearly, or only know what they've read or heard from some old-timers. A lot of this thinking is fostered by the big doses of 'stress and strain of modern living' fed to the public by a flock of so-called 'experts.' Mental illness is a very real thing in today's world, but any good doctor will tell you that treatment is no field for amateurs.

"Some of the claptrap we read these days simply offers an easy excuse for lack of self-discipline. We have a 'complex' because 'life is moving too fast for us.' Grandfather didn't have one because life in his day was serene. But this theory ignores a significant fact. In those days, a 600-psi boiler was a daringly high pressure. Today, it's common. What's happened? Power-plant equipment had to be developed to meet increasing demands placed on it. Don't think for a moment that the human machine hasn't made a lot of progress in development, too, to meet demands of 'modern living.'

"But if a guy drives himself without proper food, exercise and rest, how much different is he from power-plant equipment that gets little or no preventive maintenance? A breakdown is inevitable.

"Overdoing anything is bad, always has been, always will be. But today, if a boiler drops a tube don't blame it on the fact that it hasn't been inspected for two years. Just say the poor thing is suffering from a 'complex.' "



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now...for low steam consumption – **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

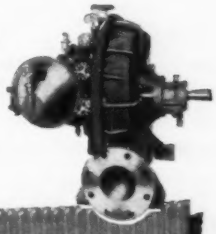
The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

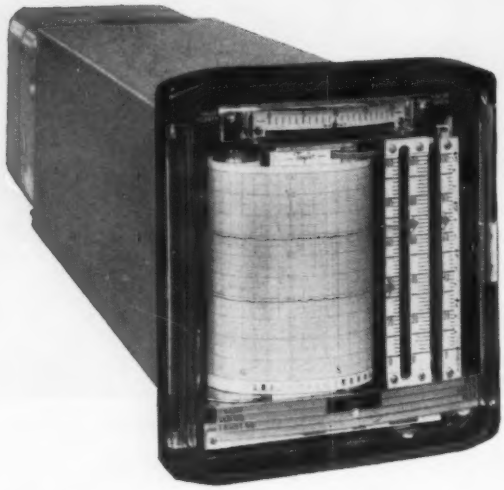
COPPUS ENGINEERING CORPORATION
169 Park Avenue
Worcester 2, Mass.
Sales offices in THOMAS' REGISTER



COPPUS "BLUE RIBBON" TURBINES

New Taylor TRANSCOPE Recorder brings you*

REVOLUTIONARY ACCURACY AND BIG-INSTRUMENT FEATURES



"No other recorder, regardless of size, puts so many features in so little panel space."

Front of Panel Control Settings let you make adjustments easier, quicker, and better . . . *from the front of the panel* . . . while recording! You can clearly see what you are doing, and the results, because the record is continuous.

Stays on Automatic Control while the recorder is removed for inspection. The unique Set Point Transmitter remains plugged in the case, providing continuous fully automatic control.

Complete Indicating Control Station while recorder is removed. You see the variable. There's no need to shut down the process for instrument service or adjustments. Horizontal gage at top of recorder will show either process variable or air output to valve, as desired.

Receives Three Variables to be recorded or indicated; has a Set Point Transmitter, an Automatic-to-Manual switching lever, a Cascade or process-output indicator, and many other features . . . all in a compact case.

"SERVOMATIC" Motor assures lifetime accuracy of pen position. Transmitter signal is received and amplified by individual force-balance servomechanisms. Spring feedback and powerful pneumatic motor give 150 times greater power than normally available for pen positioning.

0.1% Threshold Sensitivity—a new standard of accuracy. Responsiveness to transmitter output is 0.1%, and because of the very small pneumatic displacement of the input capsule, is practically instantaneous.

Optional Alarms. Each SERVOMATIC motor can operate either an electric or pneumatic alarm. Each alarm can be adjusted for one high and one low, or two high or two low operating points.

For Further Information about this revolutionary new recorder, see your Taylor Field Engineer, or write for **Catalog No. 98286** Taylor Instrument Companies, Rochester 1, N. Y., or Toronto, Ontario.

*Trade-Mark

MADE FOR EACH OTHER!

The Taylor TRANSCOPE Controller and Recorder are companion instruments. Together they give you new standards of process control performance . . unprecedented accuracy and adaptabilty.

Ideal for the time constants of modern processing, exceptionally fast and responsive to adjustments, the TRANSCOPE Controller is also highly adaptable and simple to maintain. Write for **Bulletin 98278.**

Taylor Instruments

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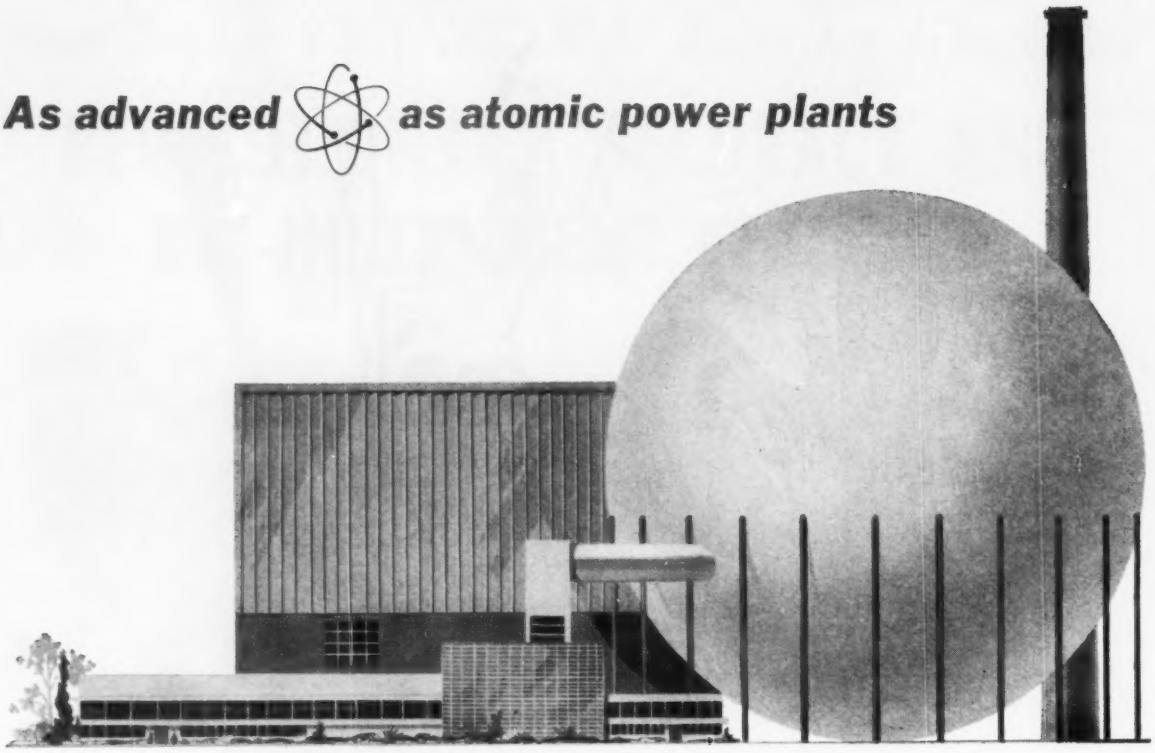


INFILCO ION EXCHANGERS

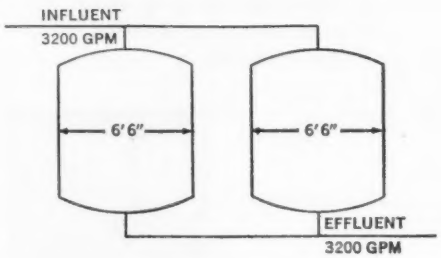
treat boiling water reactor condensate at

50 GPM PER SQUARE FOOT

Two 6'-6" diameter mixed bed demineralizers with a total surface area of 64 sq. ft. are now being installed to handle 3,200 gpm of reactor condensate. These units will produce polished condensate with a conductivity of approximately 0.1 micromho in a fraction of the space and at much lower installation cost than conventional equipment.

The plant design is based upon extensive pilot plant studies using a 24" diameter unit to treat unfiltered condensate at 200 gpm (68 gpm per sq. ft.). The equipment and techniques developed for this plant are also applicable to high pressure conventional and super-critical pressure plants.

Results of pilot plant studies and design features of this ultra-modern installation will be sent free upon request. Write today for Reprint #88.



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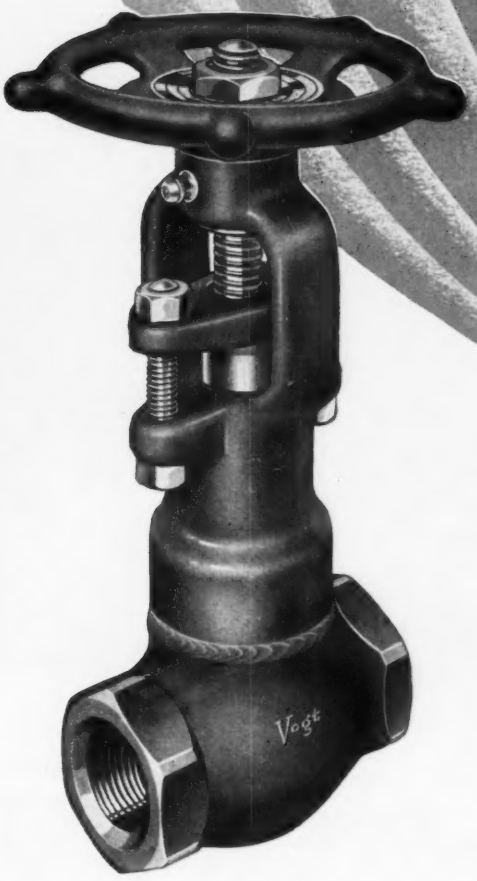
THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment. 68501

Another addition to the Vogt line of TOP QUALITY valves . . .



Forged Steel
WELDED BONNET

GENERAL GP PURPOSE

Gate and Globe
VALVES

150-800 Pounds Service

To eliminate forever potential body-bonnet leaks, Vogt engineers have developed these new General Purpose valves with seal welded bonnet joints.

This new addition to the world's most complete line of forged steel valves incorporates all the features of other Vogt GP valves—hard faced seats, hardened stainless steel wedges, drop forged pressure parts, and the numerous other advantages of Vogt's valve line.

The desirable safety feature of a back seat on the stem is retained while still offering the elimination of a possible body-bonnet leak.

Available NOW in both gate and globe types, ¼" thru 2", and in both socket weld and screw ends. These are priced identical to the bolted bonnet GP valves; gate valves the same as Series 12111 and globe valves the same as Series 12141.

Address Dept. 24A-FP for literature

Series 2801 Gate Valve
Illustrated

Series 2821 Globe Valve
Also Available

Both series identical in dimensions and have 13% chrome stainless steel trim.

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GENERAL GP PURPOSE

Vogt FOR BETTER VALVES

HENRY VOGT MACHINE COMPANY, Louisville, Ky.

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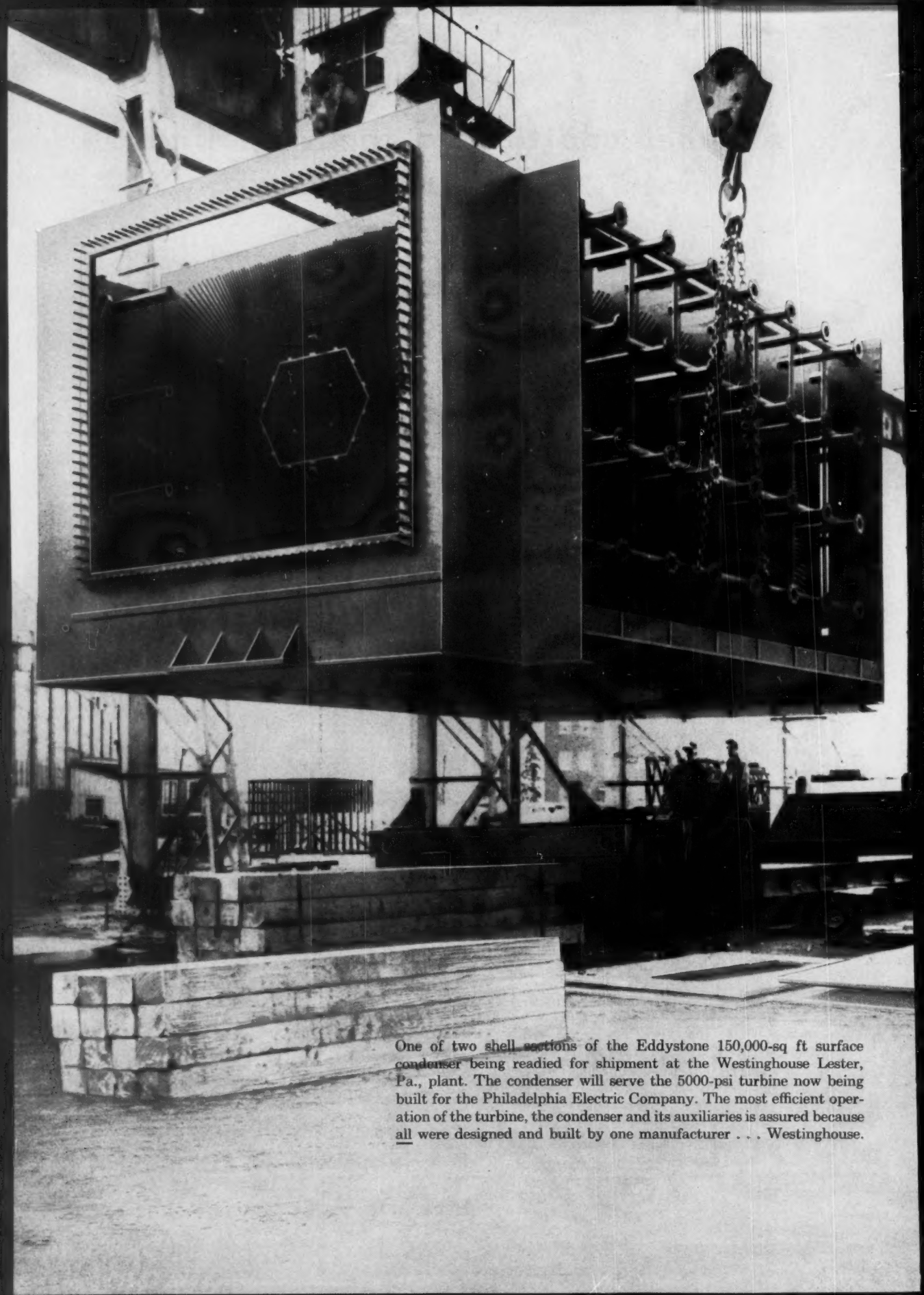
FORGED STEEL
VALVES



One of two shell sections of the Eddystone 150,000-sq ft surface condenser being readied for shipment at the Westinghouse Lester, Pa., plant. The condenser will serve the 5000-psi turbine now being built for the Philadelphia Electric Company. The most efficient operation of the turbine, the condenser and its auxiliaries is assured because all were designed and built by one manufacturer . . . Westinghouse.

New Westinghouse Condenser will help Eddystone 5000-PSI Turbine set world's efficiency record

ANOTHER GIANT STEP has been taken towards the completion of Philadelphia Electric Company's Eddystone station.

Westinghouse has shipped the 150,000-sq ft surface condenser to serve the world's most efficient turbine. Now being built by Westinghouse, the Eddystone turbine will use the highest temperature and pressure steam ever projected...5000 psi at 1200°F.

New Condenser

Because the Eddystone station will use a once-through steam generator, Westinghouse and Philadelphia Electric engineers jointly developed several new features for this surface condenser. *Both of these Westinghouse "firsts" were announced to the industry during the early design stages.*

The detection and location of even *small* leaks are made possible by twenty sampling compartments in the condenser's upper hotwell and collecting trays below the tube sheets. The lower hotwell is divided into three sections, and if any one becomes contaminated, the condensate can be by-passed into a water tank.

Through the second feature, during start-up or in the event of a trip-out or emergency, steam must be diverted from the turbine to the condenser. To protect the condenser from high-pressure and high-temperature steam, this steam is passed through four condenser injection coolers, which act as desuperheaters and pressure reducers.

Fifty Years of "Design Firsts"... Through Plowback of Earnings into Research

The installation of this Westinghouse condenser marks the 50th anniversary of Westinghouse research in designing and building surface condensers. During the past 50 years, Westinghouse has developed many of the *basic* condenser designs that today help the industry to produce low-cost electricity. Westinghouse "design firsts" include radial-flow, air ejectors, steel diaphragms for tube expansion, vertical propeller pumps and reverse flow valves.

Because of its vast and continuing research projects, Westinghouse has been traditionally *first* with design improvements. That's why it pays to specify Westinghouse. *You get today... the surface condenser of tomorrow.*

For complete information, contact your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-50608

Research developments now underway

Through Plowback of Earnings into research, Westinghouse is pioneering many condenser developments that will do much to help the industry meet future loads with low-cost electricity. Following are a few of the projects that are underway in the $6,000,000 Westinghouse Steam Development Laboratory.

Lower costs for foundations

Westinghouse research and development engineers are exploring new structural designs that promise to slash the weight and size of surface condensers and result in lower costs for foundations.

Dropwise condensation for improved heat transfer

If tube surface were nonwettable, steam would condense as droplets, rather than as a heat-barrier film. Westinghouse is searching for the water repellent that will keep the tubes nonwettable *throughout the life of the condenser*. This research project will result in improved heat transfer rates . . . and permit a great reduction in the size, weight and cost of condensers.

Reduction of aerodynamic losses

Westinghouse engineers are probing all the interrelated causes of aerodynamic losses in the transition section between the turbine and the condenser. These studies, made in cooperation with the turbine department, are leading to design changes that will give the industry condensers that are not only smaller, but more efficient.

Greater velocity for increased efficiency

The greater the water velocity, the better the heat transfer rate. Also true — the greater the velocity, the shorter the life of the tubes. In the Westinghouse Steam Development Laboratory, engineers are busy studying ways to prolong the life of tubes subjected to water velocities greater than the present seven to eight feet per second.

YOU CAN BE SURE...IF IT'S **Westinghouse**

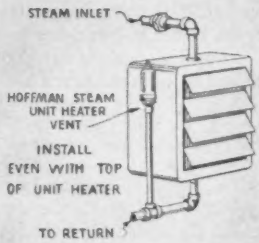
FOR MAXIMUM EFFICIENCY

USE HOFFMAN VENTS

To get top performance on Steam Unit Heaters, Steam Heating Systems, Steam Process Work, Hot Water Heating Systems, Domestic Water, Summer-Winter Units—Water Process work, air must be eliminated. Hoffman Vents are designed to vent the air accumulations so that the equipment will function effectively.

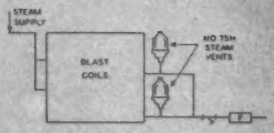
Installation of these vents now on old or new jobs will insure the maximum efficiency of the equipment.

NO. 74 VENT FOR STEAM UNIT HEATERS



To insure best results, Steam Unit Heaters must be "piping hot." The No. 74 vent is a float type vent especially designed for use with Steam Unit Heaters. This vent will expel the air as it accumulates.

Size Connection: ¾" male, ½" female. Maximum Operating Pressure: 35 P. S. I.

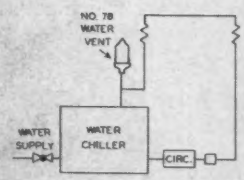


NO. 75 H STEAM VENT

An air vent for systems, supplied with steam from constant source such as District Heating, Pressure Reducing Stations and Zoned Systems.

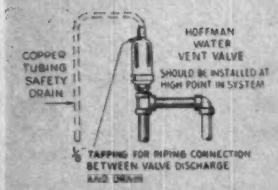
Size Connection: ¾" male, ½" female. Venting Pressure: 10 P. S. I. System Pressure: 15 P. S. I.

NO. 78 HIGH PRESSURE WATER VENT



Designed for use on high pressure hot or cold water mains and process applications. Cast brass body. Safety drain connection for discharging moisture entrained in the vented air. Has drain tube fitting and ferrule for ¼" O.D. tubing.

Size Connection: ¾" male, ½" female. Maximum Operating Pressure: 150 P. S. I.—will withstand hydrostatic pressures of 450 P. S. I.


COPPER TUBING SAFETY DRAIN
HOFFMAN WATER VENT VALVE
SHOULD BE INSTALLED AT HIGH POINT IN SYSTEM
TAPPING FOR PIPING CONNECTION BETWEEN VALVE DISCHARGE AND DRAIN

NO. 79 WATER VENT

For good circulation on any water system (hot or cold) it is necessary to let the air out. The No. 79 vent is designed for use on hot or cold water mains and process applications. Tapped at top for ⅛" I. P. S. safety drain connection for discharging moisture entrained in the vented air.

Size Connection: ¾" male, ½" female. Maximum Operating Pressure: 75 P. S. I.

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Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems, stocked and sold by leading Wholesalers of Heating and Plumbing Equipment.

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AIR CONDITIONING, HEATING

1 **Air-conditioning units** are topic of 54-p bulletin 786. Discusses special design features, standard accessories, selection steps, capacities. Includes diagrams, tables. American Air Filter Co, Inc, 215 Central Ave, Louisville 8, Ky.

2 **Cycloidal blowers** for vacuum service are discussed in 14-p booklet VP-158. Includes construction, technical data. Full-color cutaway illustrates features. Dresser Industries, Inc, Roots-Connersville Blower Div, 900 W Mount St, Connersville, Ind.

3 **Air treatment,** distribution products are covered in 32-p booklet D-5199. Book has sections on air handling, conditioning, heating and electronic air cleaning. Westinghouse Sturtevant Div, Dept T-189, 200 Readville St, Hyde Pk, Boston 36, Mass.

4 **Heating** is topic of 8-p brochure 587. Discusses how to heat gas, vapor, liquid with indirect-fired heaters. Includes application photos. Brown Fintube Co, Elyria, Ohio.

BOILERS AND ACCESSORIES

5 **Coal-fired** packaged steam generators up to 200 psig are discussed in 10-p bulletin 1100. Photos, diagrams illustrate features. International Boiler Works Co, E Stroudsburg, Pa.

6 **Bent-tube boilers** are covered in 22-p bulletin VF-VS 2. Diagrams illustrate various installations from 26,400 to 675,000 lb steam per hr. Henry Vogt Machine Co, Louisville 10, Ky.

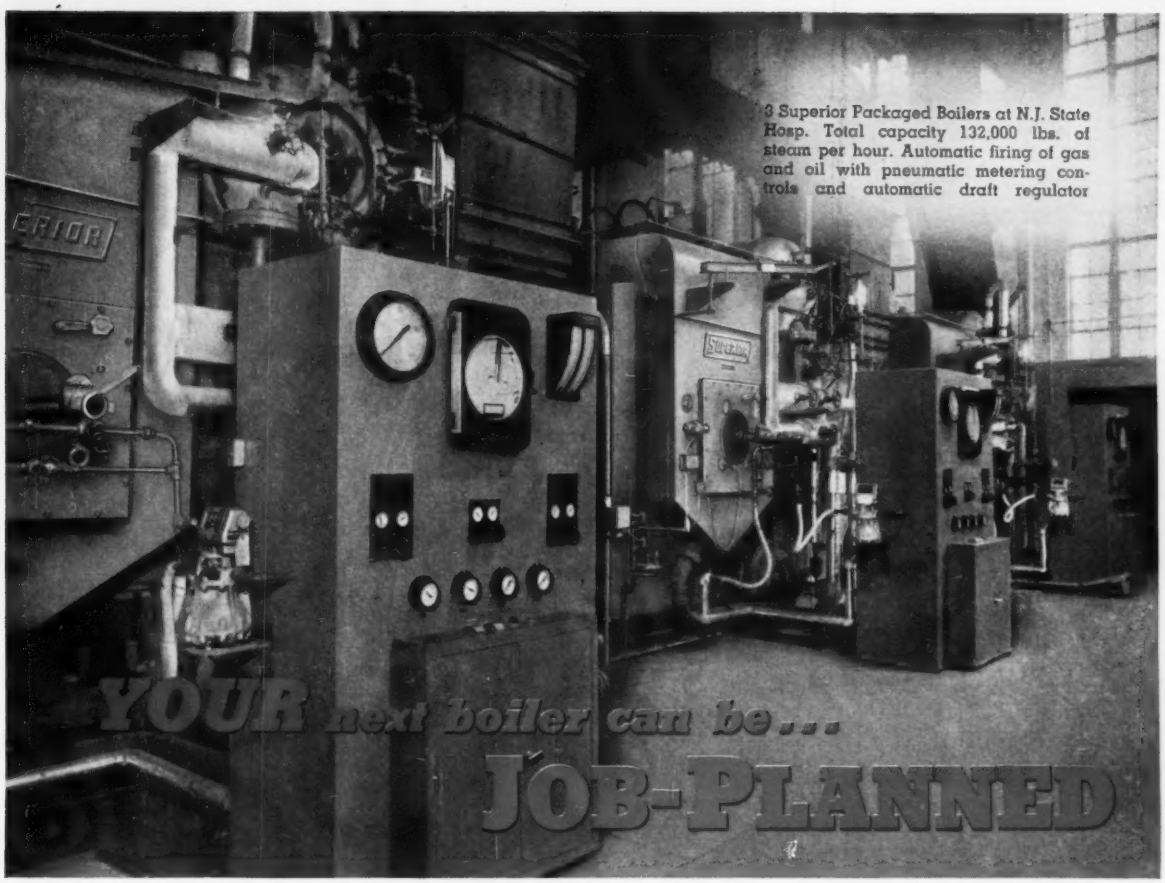
7 **Watertube** packaged boiler for oil, gas, coal is described in 20-p catalog VLP. Diagrams, photos, tables included for factory-built and field-erected units. Erie City Iron Works, Erie, Pa.

8 **Cyclone dust collectors** are described in 8-p bulletin C-958. Gives detailed description of design, structural features; application drawings. Ducon Co, Inc, 147 E Second St, Mineola, N. Y.

ELECTRICAL EQUIPMENT

9 **Dry-type transformers** are discussed in 20-p buyer's guide GEC-1600. Includes 60-cycle indoor or outdoor single- and 3-phase units. General Electric Co, Schenectady 5, N. Y.

10 **Butyl insulation** for wire and cable is analyzed in 28-p booklet. Includes charts and technical listings giving data on electrical qualities, heat serviceability, temperature resistance and aging properties. National Electric Products Corp, Gateway Center, Pittsburgh, Pa. *(Continued on page 164)*


3 Superior Packaged Boilers at N.J. State Hosp. Total capacity 132,000 lbs. of steam per hour. Automatic firing of gas and oil with pneumatic metering controls and automatic draft regulator
YOUR next boiler can be...
JOB-PLANNED

and FACTORY-FIRE-TESTED . . . Too!

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Capacities to 50,000 lbs. per hour.
Design pressure to 900 p.s.i.g.
Fully or semi-automatic operation
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Steam or air puff soot blowers.
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All this with undivided responsibility, guaranteed performance and efficiency for minimum maintenance.

Why not choose your "guaranteed" packaged boiler to meet the needs of your job, just as you would when specifying a field-erected plant, and still get the advantages of factory assembly, factory-fire-testing, and most important, undivided responsibility?

The Superior Packaged Boilers pictured here are "job-planned" units incorporating burner and control equipment as specified by the purchaser, and tested at actual working conditions before shipment.

Testing involves all functional equipment: forced draft fan, burner, combustion controls, programming equipment, etc., mounted or connected to the boiler, thus providing a guaranteed product with undivided responsibility. Why settle for less? Why purchase half a package? For details write for Catalog 1000-W.

Specialists in PACKAGED BOILERS . . . exclusively

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TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
PACKAGED BOILERS

RAMBLINGS ON INSTRUMENTATION

Tom Schwift and His Marvelous Flow Transmitter

ONE somnolent August morning, as kindly old Dr. Harding was potting some tea roses in his greenhouse, his attention was distracted by a familiar rapping at his door. "Tom Schwift!" he exclaimed. "Come in, lad!" A moment later Tom Schwift (for it was indeed the young inventor) strode through the door.

"Aha, young Tom!" exclaimed the professor. "Tell me, what have you been inventing now, for I detect a note of ill-suppressed excitement in your demeanour."

Blue eyes a-twinkle, the young genius nonchalantly vaulted a row of nasturtiums. "Oh, nothing much," he remarked casually. "Come have a look."

"Smaller than a breadbox!" expostulated the professor.

Back at his laboratory, young Tom beckoned casually toward a draped object in the corner. Spine a-tingle with anticipation, the beloved old professor snatched aside the drape. A gasp escaped his beloved old mouth. For, truly, this latest invention appeared a worthy successor to The Electric Bath Mat, The Automatic Gravy Boat and The Mechanical Chicken Plucker which had brought fame to the modest young genius.

Brushing the mist from his wise old eyes, Professor Harding queried, "And, pray tell, what is it, boy?"

Quelling his amusement at his elder's ignorance, (for he was never one to display impatience in the presence of less nimble wits), young Tom launched into an explanation.

"I've dubbed it the Tom Schwift Flow Transmitter, sir," bespoke the lad, modestly lowering his lashes.

"Bless me!" expostulated Dr. Harding. "But——"

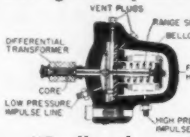
"Notice," Tom went on, "that the entire unit is hardly larger than a steam turbine. Pressure differentials are recorded in this seven-gallon mercury tube, activating a cleverly designed torquing system, which in turn is transmitted to a series of bellows, forcing air into a Navy weather balloon. In early tests, the balloon frequently sailed off with the whole shebang. This difficulty I resolved by bolting the unit to a concrete slab."

Dr. Harding nervously polished his pince-nez. "My boy," he pontificated gently, "the best of us occasionally . . . ahem . . . well, *goof*!"

"You mean . . . ?" stammered the lad.

"I fear it is all too true," interjected the older man. "Yes, young Tom, once again Hays has beaten you to the punch! The Hays Model 245 Differential Pressure Transmitter has many points of clear superiority over your crude contraption . . . and, upon my word, over all the devices I know about in the flow measurement dodge."

"Smaller, I suppose," brooded Tom, staring moodily out the window.



"The Hays Transmitter is frictionless and liquid-free."

"Smaller than a breadbox," rejoined the other. "Also there are no torque tubes, gears or like that . . . *nothing*, my boy, in the way of mechanical friction. The differential transformer core moves *directly* with the bellows. And the Hays transmitter uses none of that costly mercury, lad. It is liquid-free, the only sensing unit being the single element bellows."

"Jehosophat!" muttered Tom testily.

Warming to his subject, the kindly professor continued: "Another fascinating spec of Hays Fantastic Flow Transmitter, if memory serves, is a guaranteed recorded accuracy of ±¼% of full scale signal above 10% of scale!"

Sensing that his young associate had ceased paying attention, Dr. Harding tiptoed to the door. Closing it gently, he heard the blue-eyed young genius muttering . . . "Wonder if those chaps at Hays have thought of an electric salt shaker!"

(Gentle reader, write for Bulletin 58-1228-107 or "The Hays Boys in the Catskills.")

Phil Sprague Jr. President

THE HAYS CORPORATION • MICHIGAN CITY 3, INDIANA

Marmaduke

Continued from page 130

big dredging job he was bidding on. But he was afraid that a large competitor would underbid him.

"Frank explained his biggest problem was getting his largest suction dredge into the small inner bay where the dredging was to be done. Because he couldn't get his dredge under the wooden highway bridge, he figured he'd have to add at least $10,000 to his bid to cover taking the dredge apart and shipping the pieces overland by truck to the dredging location. That problem interested me, so we drove out to the bridge where I got the lay of the land.

"The wooden bridge was a half mile inland from the bay, and connected two busy bay areas. Clearance under the bridge was only eight feet at low tide. Fred told me there were no movable parts to the bridge so he'd have no choice but to bypass it with his dredge.

"His problem looked tough, all right. We sat there watching the busy 2-way traffic crossing the wooden structure.

" 'I'm sure I could have the low bid,' Frank explained, "if I could only knock off that $10,000 in dismantling and trucking costs. Hell, I don't think my competitor has brains enough to solve this problem, either.'

" 'What's it worth to you if I get your suction dredge past that bridge without dismantling her?' I asked.

"Frank gave me a fishy look, then answered, 'Marmy, if you do that, you got yourself an easy $3000, in cash, on the barrelhead.'

"That was all I wanted to hear.

"Instead of showing up at the shipyard on Monday, I did a little investigating locally. After a trip to City Hall and a few calls to the State Highway Commission that morning, I learned some interesting facts. One was that the bridge could be taken out of service — but for only 24 hours. There was a 20-mile detour around the bay that traffic could use in the meantime.

"Checking the tide tables, I learned that the highest tide for the month was from minus two feet to plus seven feet. That gave me nine feet to figure with.

"That night I told Frank my plan —it all depended on the State High-

(*Continued on page* 156)

HERE'S A
SPECIAL ADVANTAGE
OF THE
LJUNGSTROM:®

high availability

These five basic factors assure you that the Ljungstrom Air Preheater will give exceptionally long periods of uninterrupted availability:

1. UNIFORMLY HIGHER COLD-END METAL TEMPERATURES. This minimizes the danger of local corrosion due to cold spots.

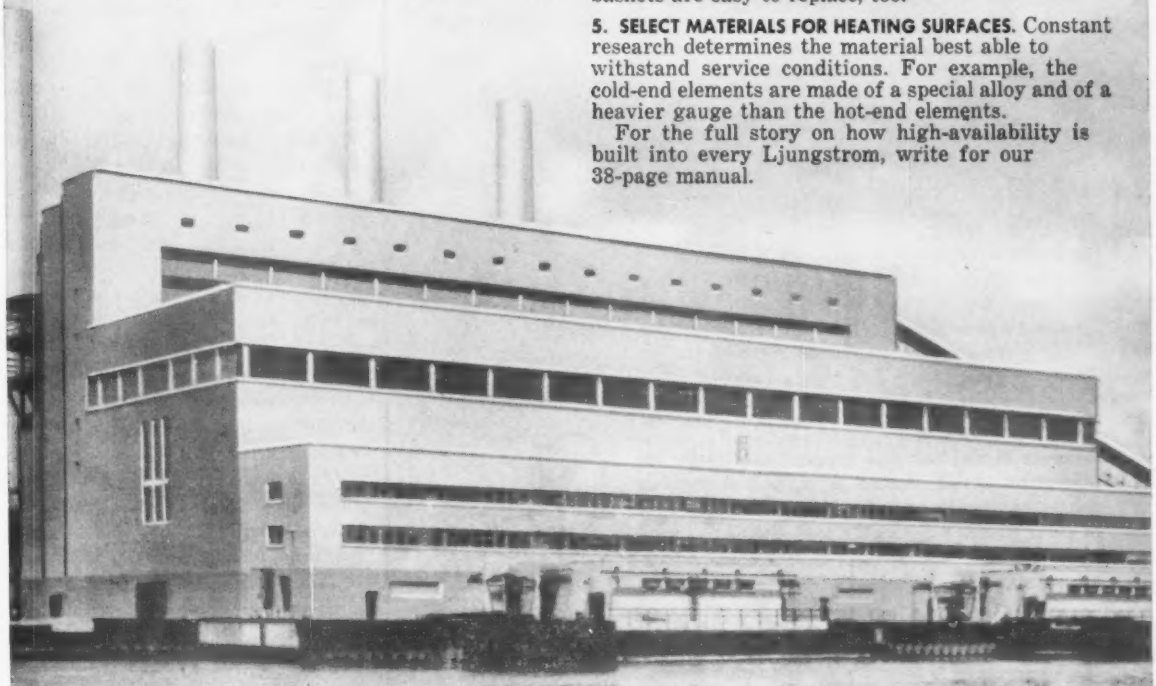
2. POSITIVE CLEANING ACTION. A mass-flow soot blower is normally installed at the cold end of the Ljungstrom where deposits are most apt to accumulate. Daily cleaning with superheated steam or compressed air removes any deposits.

3. INSPECTION PORTS. You can see for yourself, at any time, the condition of the heating surfaces.

4. REVERSIBLE COLD-END BASKETS. Elements in the cold end are separated into small baskets, which can be inverted when one end starts to wear thin. These baskets are easy to replace, too.

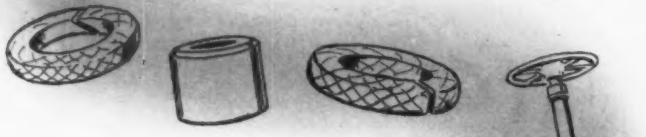
5. SELECT MATERIALS FOR HEATING SURFACES. Constant research determines the material best able to withstand service conditions. For example, the cold-end elements are made of a special alloy and of a heavier gauge than the hot-end elements.

For the full story on how high-availability is built into every Ljungstrom, write for our 38-page manual.



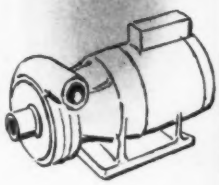
The Air Preheater Corporation 60 EAST 42nd STREET, NEW YORK 17, N. Y.

As a pioneer manufacturer of mechanical packings, Allpax has had extensive experience in developing and fabricating packing materials for the most exacting requirements of industry. Allpax rings for valves and pumps have proved themselves consistent winners through performance and preference in the field. All types are supplied in either molded, mandrel cut or endless form with butt or mitre joints.



✔ *For manufacturers —*
Allpax Rings cut costs and do a better job because they are precision-made in a complete range of sizes and a wide variety of materials. Right types available for each pump or valve requirement for whatever material handled.

✔ *For replacement —*
Accurate dimensions and proper types make replacement easier — insure a tight seal without danger of scoring or unnecessary wear on shafts or valve stems.



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Marmaduke

Continued from page 154

way Commission's approval in case he did get the contract.

"Three weeks later Frank's bid turned out to be the lowest by $5000, so he got the job. I quit the shipyard and went to work for him.

"After working out our schedule to the minute, we got everything ready. A few days later we towed a big barge under the wooden bridge at low tide and placed cribbing on the barge's deck to shore up the bottom of the bridge span. The traffic was detoured at 8 pm that evening, and we started cutting the bridge span that was over the barge with crosscut saws. When the tide came in, the barge raised the sawed bridge span. We towed the barge carrying the span down the channel and anchored it. Then, we brought the big dredge up the channel past the open bridge.

"Next, we towed the barge with the bridge section back into place. We had bolted strap iron cradles at both ends of the cut bridge so it would receive the span we had removed. It was high tide and the span lowered into place as the tide ran out. The barge was towed out from under as soon as it was free.

"The entire job took exactly fifteen hours. By 11 am traffic started across the bridge again. Frank could use the same method for moving his dredge out into the bay after the job was completed.

"Smigoski paid me the $3000 and gave me a steady job keeping his floating equipment in repair during that dredging operation.

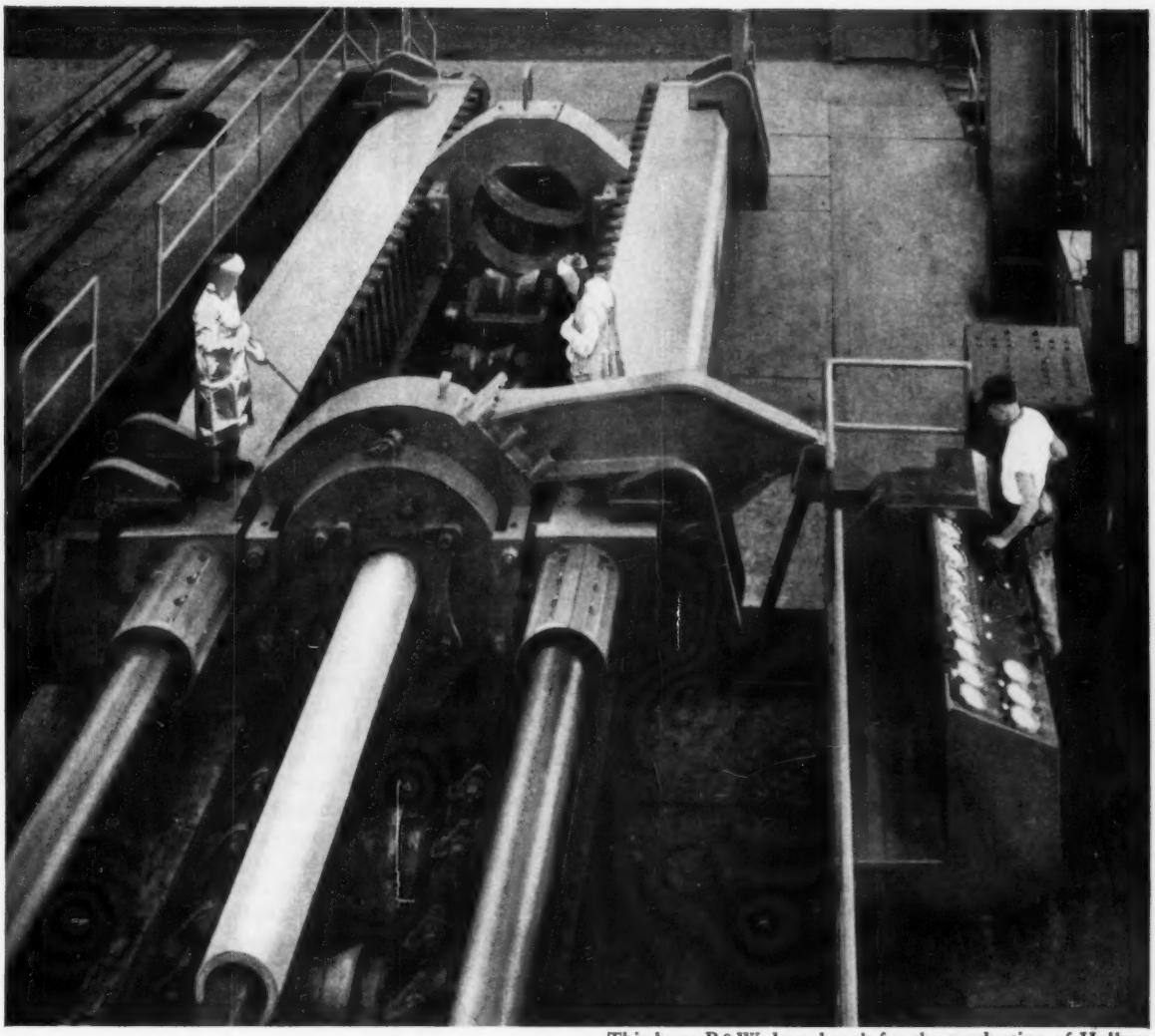
"That winter a red-headed barmaid from the Jolly Roger Cafe that I had been dating steady started getting serious. So I signed aboard a tramp freighter heading for Australia. In Sydney, I cleaned up a sticky heat-balance problem and all I did was put three pregnant kangaroos and a tired duckbill platypus to work. But that's another story," roared Marmaduke, as he suddenly started pawing through his blueprints again.

—SME

POWER AND MARMY

We at the Hale Organ works enjoy reading POWER. We especially look for Marmy's engineering stories.

C HALE, *El Dorado, Ark.*



This huge B&W draw bench for the production of Hollow Forgings is capable of taking a 26,000 pound pierced ingot.

B&W Hollow Forgings —for piping economy in heavy-duty service

Petroleum and power engineers have found a solution of their piping problems at B&W. They save time and money by specifying high-quality B&W Hollow Forgings that have been produced under carefully controlled conditions from initial electric furnace melting through final inspection. B&W production techniques include uniform and thorough working of the ingot, which result in excellent forging properties.

Piping is being supplied in a wide range of fractional sizes and a selected range of standard pipe sizes in carbon, intermediate Croloy and stainless Croloy steels.

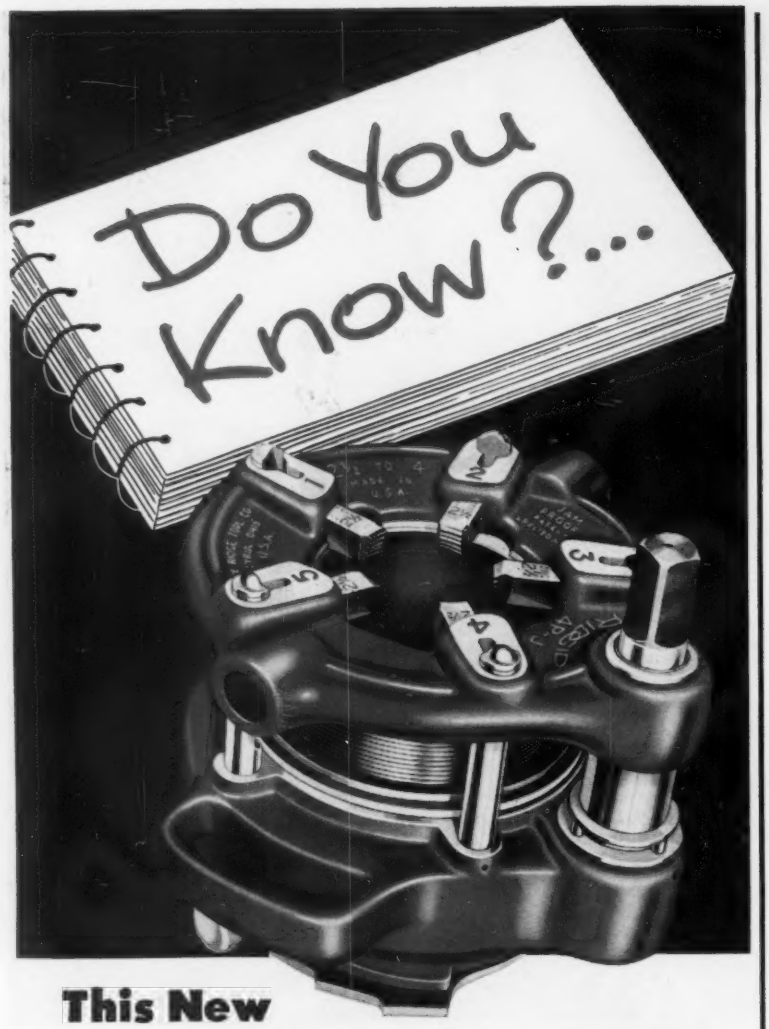
For additional information, write for Bulletin S-16. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.

S-474-HP

Ask for this BULLETIN: S-16

BABCOCK & WILCOX

BOILER DIVISION



This New

RIDGID 4PJ

is the only 2½″ to 4″ geared threader that's

Jam-Proof

It's safe—can't jam and knock equipment around when you thread pipe by power drive Automatically kicks out after standard thread is cut. Workholder sets to size *before* putting on pipe — other easier work features. See it at your Supply House!

The Ridge Tool Company, Elyria, Ohio, U. S. A.

My biggest boner...

happened to the chief engineer's son who was put in charge of a new branch plant. Shortly after he was on the job a plant wing was built within a few feet of the plant's open-vented blowoff tank. Blowdown went to the town's sewer. Trouble started when a strong west wind blew spray from the vent pipe against the new building, messing up the paint and smearing the windows.

The new chief told the office that it would cost about $1000 to move the tank, but explained he could solve the problem for only $5. He had a mechanic plug the 6-in. vent line.

About six o'clock one morning, the fireman on night duty started to blow down the boilers. You guessed it. The sewer started to backfire for blocks around. Plumbing was ruptured in homes and gunk was blown all over bathrooms, creating a horrible mess. Sections of sewer were blown up and the old rust-eaten blowoff tank let go, blowing a geyser of earth, steam and debris all around. There wasn't a window left in the new office building. The chief's house was hit like the rest. But, he must have known what caused the trouble because he never showed up at the plant and blew town in a hurry. Since then I've had a deep respect for vents.

A H MOULTON, *Pittsfield, Mass.*

Westinghouse Electric Corp is building a 3600-rpm turbine-generator for Pacific Gas and Electric Co.

A pilot plant to produce three tons per month of tantalum and columbium is being built by U.S. Industrial Chemicals Co.

PLAN '59 *Modernize now for growth and profits*

POWER's Plant Design issue will be ushered in next month. It will be our contribution to the *McGraw-Hill PLAN '59* editorial program aimed to show how industry and all America can benefit by modernization of plant and equipment. Watch for it!

Generators

Continued from page 97

Next, purge the cooling system with carbon dioxide and then fill with hydrogen. If time is limited, you can do this with the unit running, but you may use 50 to 100% additional gas, because the gas is diffused rather than stratified.

Hydrogen cooling systems are fairly complicated, and operators need thorough instructions in handling them. Manufacturers' service representatives will usually teach the operators. The men should become familiar with written operating procedures, and learn how to add hydrogen and purge the unit.

Posting a diagram of the hydrogen system near the unit with all valves numbered and normal valve positions indicated is helpful.

Generator shaft hydrogen seals depend on an oil ring carried a few pounds above hydrogen pressure. This stops hydrogen leakage. An ac motor-driven pump backed up by a dc motor-driven unit and/or by a supply from the main turbine-lubricating system supplies the seal oil.

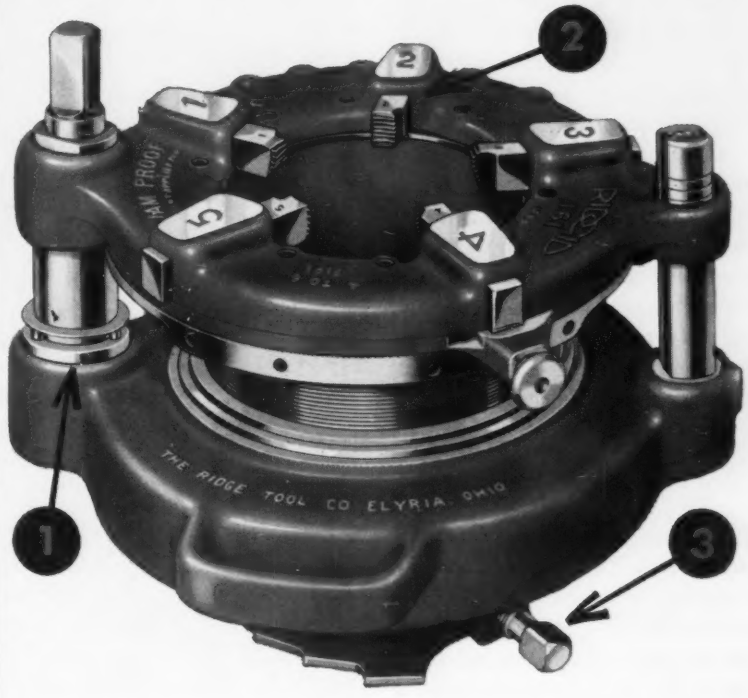
These backups furnish a dependable seal oil supply, but if unit has no dc-driven backup, station and unit are shut down, and ac power is lost, all sources of sealing oil may also be lost. Then, about the only way to keep hydrogen from blowing out into the turbine room is to vent it to waste. This reduces system pressure so leakage into the turbine room is small. If seal oil pressure loss is expected to continue for some time, purge the unit with carbon dioxide.

Gas cylinder supply. Maintaining enough carbon dioxide and hydrogen gas cylinders may be vexatious. Cylinders are often rented from a supplier who wants to minimize the number tied up at the plant.

Find out from manufacturer's data and by actual test how many bottles of carbon dioxide you need to purge the machine, both when standing still and when running. Assuming the unit is full of hydrogen, you need enough carbon dioxide to empty, refill and again empty the unit while at a standstill. This is the minimum. For hydrogen, you need at least enough cylinders to fill the unit twice when at a standstill, assuming you can get additional cylinders within a few days after ordering.

Now you thread 4", 4½", 5" and 6" pipe with only One set of dies with the New RIDGID

No. 161 4" to 6" Geared Pipe Threader



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1. Jam-Proof for safe threading by power or hand. Drive pinion kicks out automatically when full thread is cut. Die head can't jam.

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3. Plate Type Workholder sets to size *before* putting on pipe. Just one screw to tighten—no bushings.

What's more the new No. 161 has all the time-saving and proved performance features that have made the RIDGID 65R-TC and 4PJ Threaders the world's most popular. Save time on your large pipe jobs . . . order the 161 from your Supply House today!

The Ridge Tool Company, Elyria, Ohio, U.S.A.

Underground hot pipes stay free from trouble...when you INSULATE WITH GILSULATE

One of the most difficult problems in designing underground hot piping systems is providing positive corrosion protection against electrolytic, chemical or galvanic attack. The answer lies in the use of GILSULATE. For, in addition to its excellent insulating properties, this naturally-occurring hydrocarbon is chemically neutral in all soils, dielectric, and moisture-proof and water-proof as well.

GILSULATE's low thermal conductivity, low cost and easy installation make it possible for schools, colleges, housing projects, hospitals, industrial plants and other institutions to install central heating with underground piping and to realize the savings in equipment and operating costs which such systems provide.

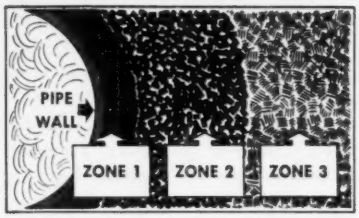
We'll help you with your plans

If you are planning to rehabilitate present piping, or to install a new underground hot piping system, call the nearest GILSULATE Distributor listed on the page opposite this advertisement. His own extensive experience in heating and air conditioning, plus the research, engineering and field supervision facilities of the American Gilsonite Company are at your disposal...without obligation. They will work with your engineers in checking specifications, unusual soil conditions, and actual installation to make sure that the finished job is completely satisfactory.

If you would like complete information on GILSULATE insulation, or would like to be put on the mailing list to regularly receive free copies of PIPE INSULATION NEWS, send your request to any of our offices.

GILSULATE IS EASY AND ECONOMICAL TO USE

GILSULATE completely frees you of the expensive, time-consuming preparation required by many insulating systems. You just pour it into the pipe trench, shovel-point it around the pipes, and tamp it. Pipe heat does the rest.



Heat fuses the GILSULATE to pipes and joints to form three zones: Zone 1, a flexible, heavy-duty water barrier; Zone 2, of firmly-cemented granular GILSULATE that provides excellent thermal insulation under wet or dry conditions; and Zone 3, which provides a final zone of thermal insulation and a support for the water-proof structure.

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Bookshelf

Turboblowers — Theory, Design and Application of Centrifugal and Axial Flow Compressors and Fans. *By A J Stepanoff, Ingersoll-Rand Co. 6¼ x 9¼, 377 pp, illust, $8. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

Basic theory for designing blowers has shown definite trends toward unification of fundamental hydrodynamic relationships for all turbomachines and away from the indirect thermodynamic basis commonly used in the past. This trend makes available the extensive experience accumulated in several related fields, especially in centrifugal pumps, to the design of blowers.

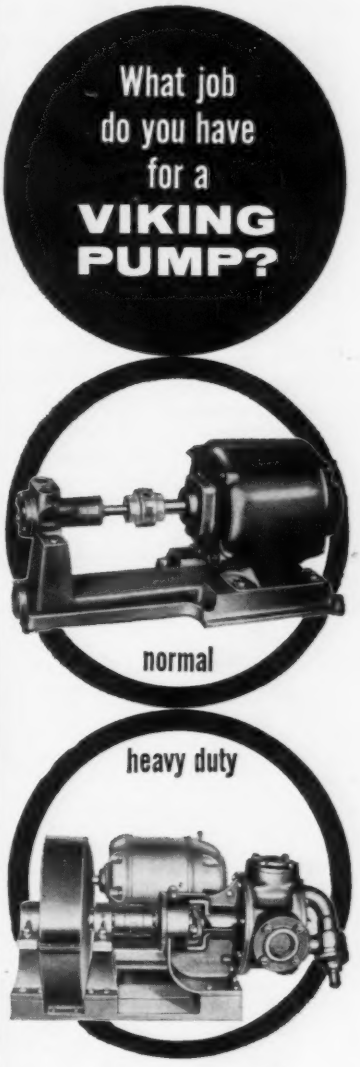
This book covers hydrodynamic and thermodynamic aspects of turboblowers. It gives the present state of the art of building turbocompressors in this country and abroad. Several important deductions known and confirmed by observations cannot be found by using internal energy and enthalpy functions alone. By using the concept of available energy these deductions can be simply developed.

Theory of axial flow impellers is built on the actual fluid deflection angle rather than airfoil lift coefficients. The forced vortex pattern of flow through axial flow stages is logically developed through this design procedure.

Chapters of the book cover: theory of centrifugal impeller, vortex theory of Euler's head for incompressible fluid, general characteristics of turbomachinery — incompressible fluid, hydraulic performance of centrifugal blowers, thermodynamics of turboblowers, blower casing, leakage, disk friction, mechanical losses, axial thrust, compression with cooling, centrifugal fans, axial flow fans, high-pressure multistage axial flow compressors, design of mixed flow impellers.

The Procedure Handbook of Arc Welding Design and Practice, 11th Edition. *6 x 9, 1300 pp, 1100 illust, $3.00. The Lincoln Electric Co, Cleveland 17, Ohio.*

This edition of the basic reference text has been extensively revised. Its eight sections are divided by subject



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LONGER LIFE . . . thru extra-heavy cast or forged construction
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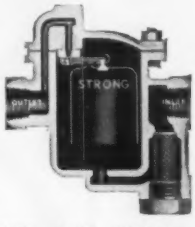
INTERCHANGEABLE INTERNAL PARTS . . . made of tough stainless steel

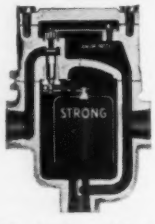
STRONG'S complete line contains a trap for every steam system: 0 to 2500 psi, 0 to 1100°F, 0 to 100,000 lbs/hour.

Horizontal, in-line traps:

140, 141, 142, 143, 144 (semi-steel): pressure-temperature limit — 250 psi at 450°F; capacities to 11,500 lbs/hour



140S, 141S, 142S (semi-steel): same as 140-142, with a built-in strainer for removing foreign matter.



140T, 141T, 142T (semi-steel): same as 140-142, with a high capacity thermal vent for faster heating

Bottom inlet, top outlet traps:

42, 43, 44, 45, 46 (semi-steel): pressure-temperature limit — 250 psi at 450°F; capacities to 42,800 lbs/hour

643, 644, 645, 646 (cast steel): pressure-temperature limit — 600 psi at 800°F; capacities to 42,800 lbs/hour

1543, 1544, 1545, 1546 (forged SAE 4130 Chrome-Moly Steel): pressure-temperature limit — 1500 psi at 950°F; capacities to 42,800 lbs/hour

642 (forged steel): pressure-temperature limit — 400 psi at 850°F; capacities to 2665 lbs/hour (not illustrated)

2544, 2545, 2546 (forged ASTM A335-P22 Chrome-Moly Steel): pressure-temperature limit — 2500 psi at 1100°F; capacities to 42,800 lbs/hour (not illustrated)

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Bookshelf

Begins on page 161

matter, each with its own table of contents. They cover history, nomenclature, weldability, mild-steel procedures, cost data, machine design, structural design, applications and reference data.

Major revision is in the structural section, which has expanded discussions of theory and application of rigid-frame and plastic design systems. The weldability section includes up-to-date zirconium and titanium specs. Mild-steel procedure section includes info on new iron-powder manual electrodes, automatic methods, hardsurfacing, carbon-arc work, tool and die welding, pipeline, piping and code welding.

Applied Protective Relaying. *By a staff of specialists. 239 pp, $3.00. Department of Technical Information, Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.*

This book is a basic text, useful for study, and for practicing relay engineers and engineers indirectly concerned with relay systems. It covers application, setting and maintenance of protective relay systems. Based on classes taught by Westinghouse engineers, the book places most emphasis on applications.

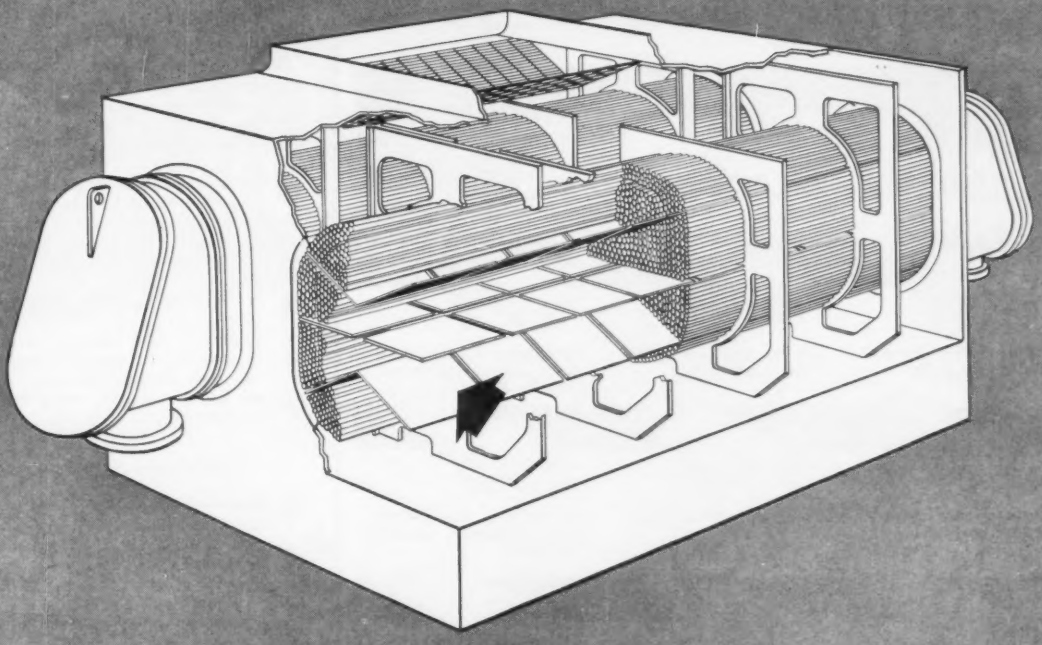
The information given includes chapters on technical tools, phasors, polarity, symmetrical components; instrument transformers; generator, motor, transformer, station bus, line and pilot protection; system stability, reclosing and synchronizing; line protection for multiterminal and tapped lines; testing and maintenance data.

Insulation Engineering Fundamentals. *By Graham Lee Moses. 117 pp, paperbound, $2.75. Lake Publishing Co, Lake Forest, Ill.*

The author, a top insulation authority, has presented important aspects of insulation in detail. Every phase is described; basic concepts, selection, application, construction and testing of insulation for large and small rotating machinery and electronic equipment.

In the back of the book there's a glossary of insulation words and phrases. Designed to help beginners as well as the experienced engineer, this book is a useful reference guide.

unique location of condensate removal trays produces most effective deaeration and higher vacuum



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ROSS SURFACE CONDENSERS

Innovations in Ross Surface Condenser design are numerous. Each provides distinct advantages.

Arrangement of the condensate trays in the 110,000 sq. ft. unit illustrated is a noteworthy example. They perform a triple service:

1 By spilling the condensate into the live steam transportation area, the trays promote effective deaeration in the main shell. Droplets are thoroughly scrubbed with live steam. Entrained non-condensibles are then released and swept into the air removal section.

2 As a result of their converging pattern, the trays maintain vigorous steam velocities for scavenging non-condensibles.

3 By reason of the trays' effective draining action, water-blanketing or flooding of the tubes is minimized. *All* tube surface in the bundle therefore condenses steam at top efficiency, with uniform heat transfer over the entire bank.

Keep your eye on the Ross design. It's packed with benefits found in no other condenser. Discuss them with a Company representative at your convenience ... and request Bulletin 8.2K1 now.

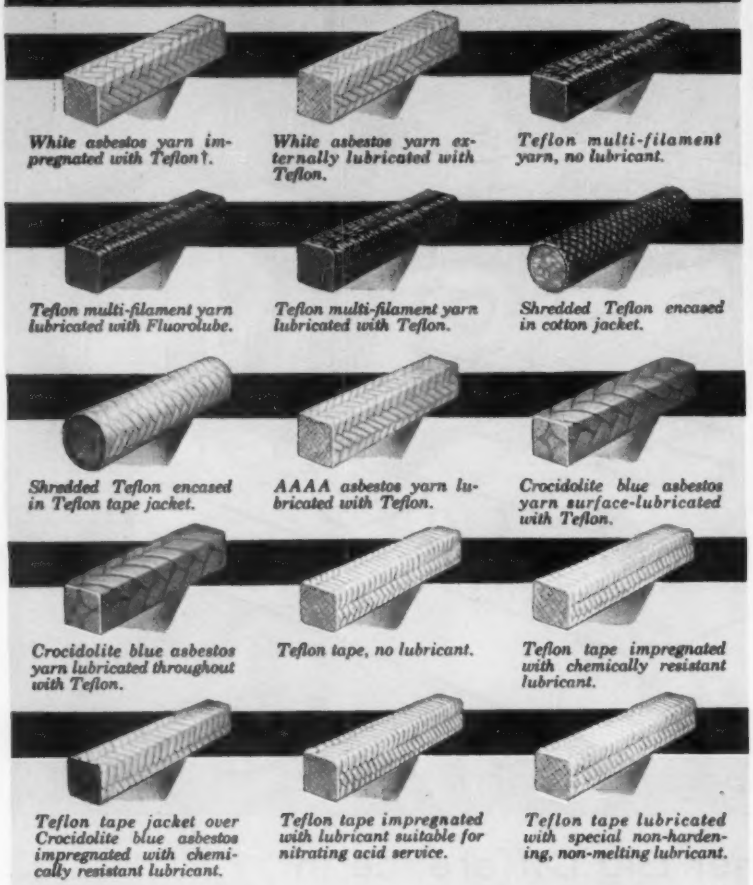
American-Standard*, Ross Heat Exchanger Division, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Station D, Toronto, Ont.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard

ROSS HEAT EXCHANGER DIVISION

15 SPECIFIC PACKINGS FOR ALL CORROSIVE SERVICES


White asbestos yarn impregnated with Teflon†.
White asbestos yarn externally lubricated with Teflon.
Teflon multi-filament yarn, no lubricant.
Teflon multi-filament yarn lubricated with Fluorolube.
Teflon multi-filament yarn lubricated with Teflon.
Shredded Teflon encased in cotton jacket.
Shredded Teflon encased in Teflon tape jacket.
AAAA asbestos yarn lubricated with Teflon.
Crocidolite blue asbestos yarn surface-lubricated with Teflon.
Crocidolite blue asbestos yarn lubricated throughout with Teflon.
Teflon tape, no lubricant.
Teflon tape impregnated with chemically resistant lubricant.
Teflon tape jacket over Crocidolite blue asbestos impregnated with chemically resistant lubricant.
Teflon tape impregnated with lubricant suitable for nitrating acid service.
Teflon tape lubricated with special non-hardening, non-melting lubricant.

John Crane CHEMLON *BRAIDED PACKINGS

Specific service conditions are always best handled with a packing designed for the purpose. This is especially true when it comes to hard-to-handle liquids in pumps, valves, agitators, mixers, plating equipment and similar applications.

For this reason John Crane has developed 15 individual field-proved types of Chemlon Braided Packings. Within this line there is a type and style that will meet any combination of service conditions and requirements.

1. All known industrial acids, alkalis or solvents.
2. Temperatures from −120°F to +600°F.
3. High or low shaft speeds, also valve stems.
4. Longer packing life due to lower coefficient of friction and non-raveling construction.

Send in your service condition and we will recommend a Chemlon Braided Packing best suited to your application. Request Bulletin P-325.

Crane Packing Co., 6430 Oakton St., Morton Grove, Ill. (Chicago Suburb).
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

†*T. M. for DuPont Teflon* **T. M. for the Best in DuPont Teflon*

CRANE PACKING COMPANY

Free literature

Begins on page 151

11 **Air circuit breakers,** switchgear products are discussed in 56-p illustrated catalog. Unit breakers and enclosures are grouped by frame size. Includes wiring diagrams, applications. I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Philadelphia 30, Pa.

12 **Insulating components** made of silicone are listed in 6-p selection guide 10-109. Describes, illustrates step-by-step procedure for winding motors. Dow Corning Corp, Midland, Mich.

13 **Silicone magnet-wire** coating is described in 4-p brochure 10-404. Includes tables, charts and design objectives. Dow Corning Corp, Midland, Mich.

14 **Stationary storage batteries** for emergency light and power use are topic of 24-p manual 210. Includes photos, graphs, tables. The Electric Storage Battery Co, Exide Industrial Div, Box 8109, Philadelphia 1, Pa.

MATERIALS HANDLING

15 **Ball-bearing troileys** are listed in 20-p booklet 2636. Units come in two series for 3-, 4- or 6-in. I-beam tracks. Link-Belt Co, Prudential Plaza, Chicago 1, Ill.

16 **Idlers** with low maintenance requirements are described in 8-p bulletin 925. Includes drawings, photos for all types of conveyor-belt units. Jeffrey Mfg Co, Columbus 16, Ohio.

17 **Conveyor-belt** trouble-shooter is a pocket-sized slide card giving a quick method for locating probable causes of trouble. United States Rubber Co, Conveyor Products, Mechanical Goods Div, Passaic, N. J.

18 **Bin-level indicators,** aerators are listed in 20-p catalog. Gives cutaway and schematic drawings, outline dimensions, specs. The Bin-Dicator Co, 13946-152 Kercheval Ave, Detroit 15, Mich.

MATERIALS

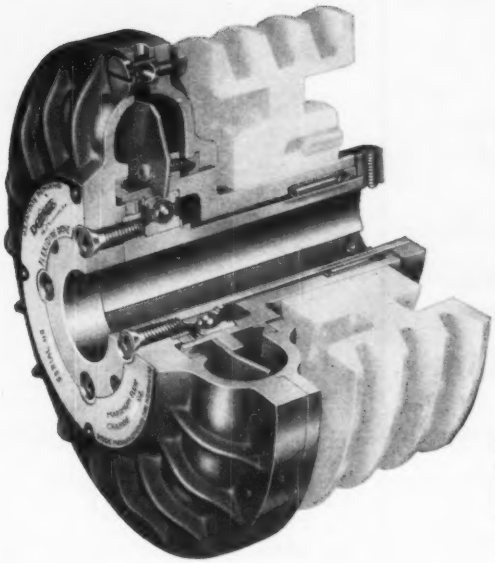
19 **Refractory brick** is subject of 24-p booklet. Includes technical data, tables, graphs, conversion charts for high-temperature applications. Norton Co, Publicity Dept, Worcester 6, Mass.

20 **Steel forgings** and super-alloy steel products are discussed in 28-p booklet. Shows steps involved in producing custom-made steel products. Midvale-Heppenstall Co, Dept S-29, Nicetown, Philadelphia, Pa.

21 **Metal-ceramics** for high-temperature service are covered in 12-p bulletin. Contains physical, mechanical, chemical properties for

WHAT'S YOUR PROBLEM?...

- ☑ Overheated motors?
- ☑ Excessive belt maintenance?
- ☑ Breakage of materials being processed —like thread, wire, paper?
- ☑ Expense of oversize or high torque motors?
- ☑ High demand rate?
- ☑ Expense of reduced voltage starters?
- ☑ Clutch trouble?
- ☑ Breakage of transmission parts due to instantaneous shock loads?
- ☑ Damage and recurring down-time from overloads?



FLEXIDYNE

THE DRY FLUID DRIVE

It is no longer necessary to accept the destructiveness—the costliness—of conventional starting in the mechanical transmission of power. Flexidyne changes that!

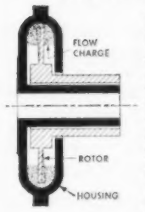
Flexidyne is the new way to start loads *smoothly*—to protect against shock and overload—to save power—all *without any sacrifice of efficiency at full load!*

This revolutionary development is ushering in "the day of the soft start"—which can mean thousands of dollars to you in equipment savings and in better, more economical operation.

Flexidyne is available, off the shelf, in Drives and Couplings. Capacities range from fractional to 1,000 hp. Ask your local Dodge Distributor or write us for technical bulletin.

DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

HOW FLEXIDYNE WORKS



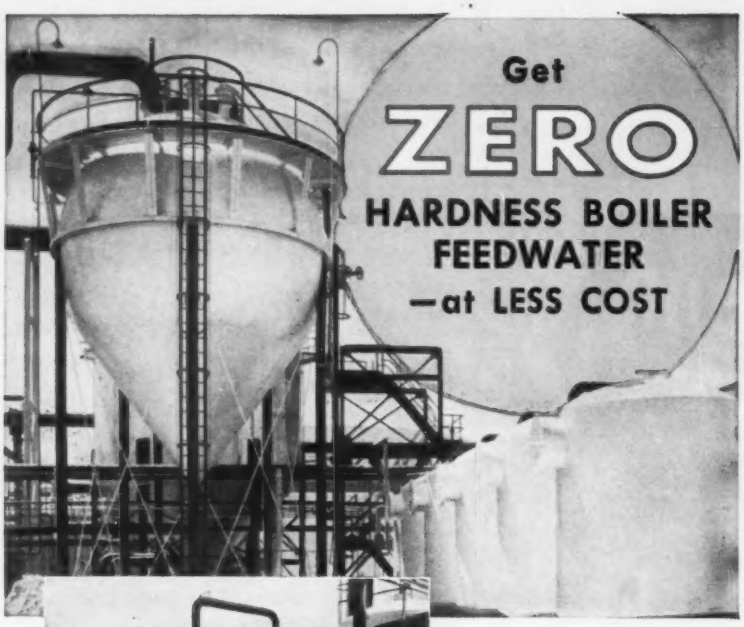
The "dry fluid" in Flexidyne is tiny heat-treated steel shot. A measured amount, called the "flow charge," is contained in the housing, which is keyed to the motor shaft. Inside the housing is a rotor, free to revolve relative to the housing, but connected to the load.

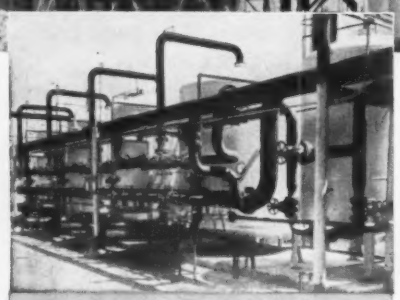
When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, packing it between the housing and the rotor, which transmits power to the load. Initial slippage is momentary. Housing and rotor become locked together and achieve full load speed without slip and at 100% efficiency.

CALL THE TRANSMISSIONEER — your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

DODGE

of Mishawaka, Ind.





Top photo shows new outdoor hot lime-zeolite softener installation in a Southern refinery. Five Nalcite HCR ion exchange units (lower photo) have output of 470,000 gallons of zero hardness water between regenerations.

with Nalcite® (DOWEX*) HCR
HOT LIME ZEOLITE TREATMENT

● Start with the simplicity of operation . . . add the low operating costs of hot lime-zeolite softening . . . all made possible by the outstanding high-temperature performance of Nalcite HCR in the zeolite softeners. Results: Zero hardness water, from virtually any raw water source, with a minimum of testing and control required. See your water treating equipment manufacturer for details on new or conversion hot lime-zeolite treatment for your plant . . . and for top softener efficiency, specify Nalcite HCR.

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Nalco® PRODUCTS

When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

Free literature

Begins on page 151

cermets for service up to 2800 F. Union Carbide Corp, Haynes Stellite Co Div, Kokomo, Ind.

CONTROLS AND METERS

22 **Variable-speed drive** and pneumatic-control systems are covered in 8-p bulletin F-1882. Drawings illustrate various applications. U. S. Electrical Motors Inc, Box 2058 Terminal Annex, Los Angeles 54, Calif.

23 **Speed-measuring instruments** are discussed in 20-p catalog 35. Illustrations, specs included. James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

24 **Electronic recorder** for recording pressure, temperature, flow, liquid level is described in 8-p bulletin-spec sheet package. Gives details on two types of receiver units, integrator and accessories. Hays Corp, Michigan City, Ind.

25 **Pressure - vacuum controls** are listed in 8-p catalog 500. Includes illustrations, capabilities, limitations, features. United Electric Controls Co, 79 School St, Watertown 72, Mass.

26 **Liquid-level control** which operates with no moving parts in the liquid is topic of 16-p catalog. Includes photos, charts, diagrams. B-W Controller Corp, 2200 E Maple Rd, Birmingham, Mich.

27 **Variable-area flowmeters** are subject of 15-p handbook 10A9010. Gives basic engineering data including tables, graphs and equations for application, sizing and flow - rate calibration prediction. Fischer & Porter Co, 795 Jacksonville Rd, Hatboro, Pa.

PIPING, VALVES

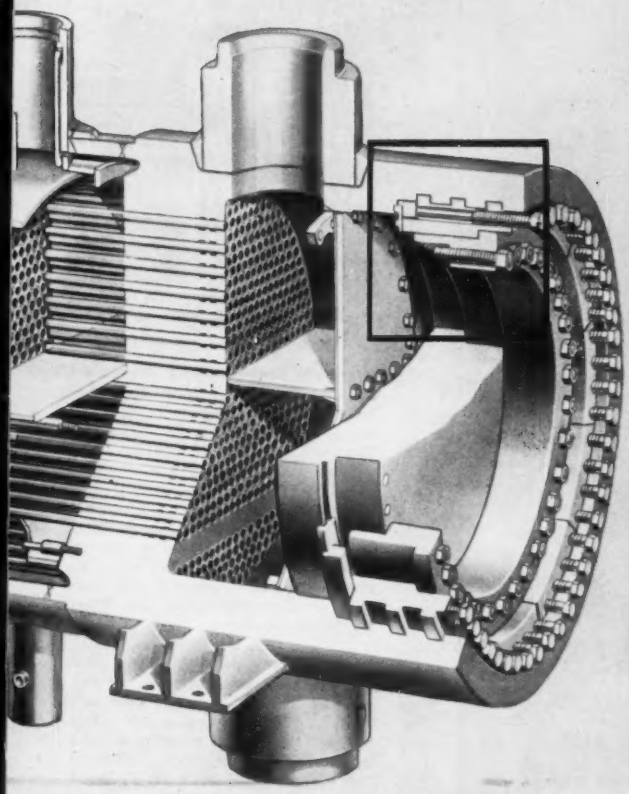
28 **Hydraulic tube fittings** are described in 28-p catalog 556. Gives design and installation info, specs. Flodar Corp, 16911 St. Clair Ave, Cleveland 10, Ohio.

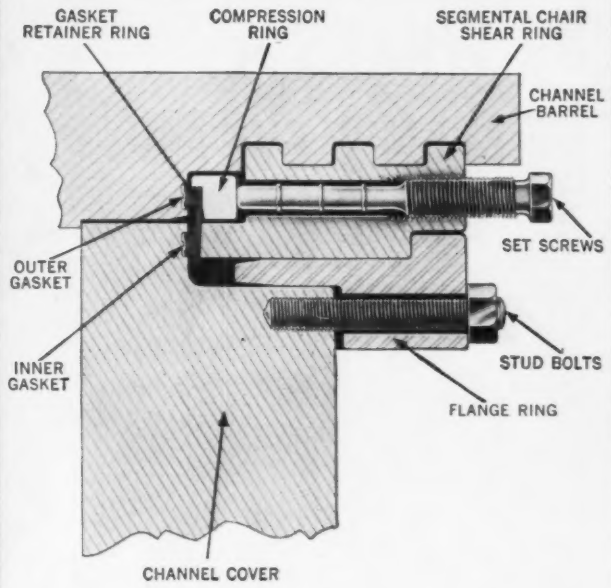
29 **Expansion joints** are described in 80-p catalog EJC-581. Gives complete data for rating joints subjected to axial or lateral movement or angular rotation, dimensions and weights for units from 3- to 72-in. dia. Badger Mfg Co, 230 Bent St, Cambridge, Mass.

30 **Magnetic** and motorized valves for air, water, gas, steam, oil and refrigerants are listed in 24-p catalog V-58. Includes flow charts for liquids and compressible fluids. Mercoid Corp, 4201 Belmont Ave, Chicago 41, Ill.

31 **Quick-coupling** for piping is described in 6-p bulletin. Photos illustrate applications. Victaulic Co of America, Box 509, Elizabeth, N. J. (*Continued on page* 168)

ALCO FEEDWATER HEATERS





Detail of Type "D" closure on ALCO high-pressure feedwater heater shows simplicity of dismounting and reassembly, isolation from contained condensate.

TWO MILLION HOURS OF OPERATION PROVE ALCO'S TROUBLE-FREE CLOSURE

The ALCO Type "D" closure, standard on all ALCO high-pressure feedwater heaters, has now rolled up more than two million hours of operation in power plants. During this time, the positive mechanical-locking design of the closure has turned in an outstanding record of trouble-free performance.

In addition, the ALCO Type "D" closure provides many other important operational advantages. The closure's locking strength is uniform. Screwed fastenings and locking devices are dry and cannot be corroded by condensate. If maintenance of tubes is necessary, the closure is easily demounted with hand tools for full access to tube ends. Reassembly is quickly accomplished with the same hand tools. For added savings, no costly and time-consuming pressure welding is necessary.

Specialists in any ALCO sales office will be happy to discuss with you in detail the design, construction and many advantages of the ALCO Type "D" closure on feedwater heaters. For an informative brochure, write ALCO Products, Inc., Dept. 135, Schenectady 5, New York.

ALCO

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Locomotives • Diesel Engines • Nuclear Reactors • Heat Exchangers • Springs • Steel Pipe • Forgings • Weldments • Oil-Field Equipment

Free literature

Begins on page 151

PUMPS

32 **Packings,** gaskets and seals, construction and uses, are covered in 12-p handbook AD-162. Deals with static sealing, dynamic sealing and special materials. The Garlock Packing Co, 423 Main St, Palmyra, N. Y.

33 **Molded cups** for pump pistons, hydraulic service and pneumatic requirements are subject of 6-p bulletin AD-145. Includes tables, photos and diagrams. The Garlock Packing Co, 423 Main St, Palmyra, N. Y.

34 **Precision proportioning** pumps are covered in 8-p catalog 604. Details, specs given for units from 6cc per min to 730 gph. Hills-McCanna Co, 4619 W Touhy Ave, Chicago 30, Ill.

35 **Centrifugal pump** of the volute type is discussed in 8-p bulletin 1440. Includes dimensions, charts, application info, a table on altitude and water-temperature correction. Dunham-Bush, Inc, West Hartford 10, Conn.

36 **Internal-gear,** sliding-vane and spur external-gear pumps in capacities from 1 to 200 gpm are subject of 12-p catalog 100. Describes operating principles and internal construction. Tuthill Pump Co, 939 E 95th St, Chicago 19, Ill.

Technical briefs

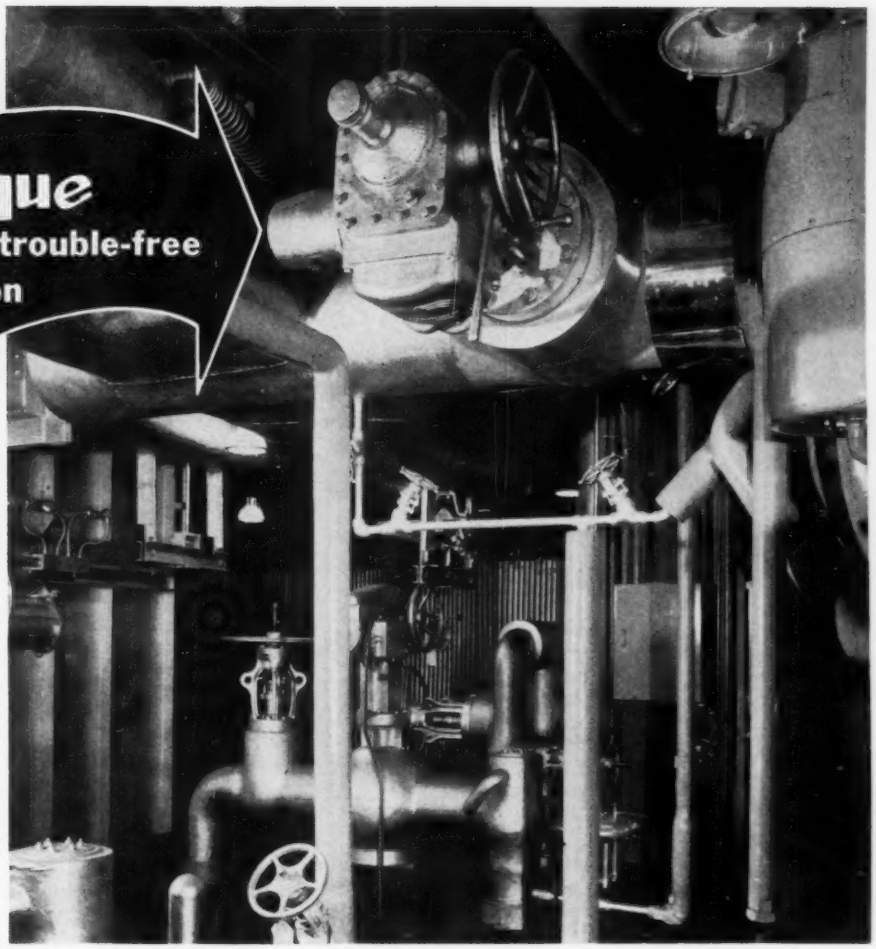
Begins on page 134

along one stator axis develops a constant-magnitude, synchronously revolving mutual flux linking the stator with the rotor.

Since the squirrel-cage motor had been developed with a revolving primary mmf, the pioneer investigators appeared to assume that a revolving primary mmf is an essential element of the squirrel-cage motor. This apparently suggested the double-revolving field single-phase squirrel-cage motor theory based on the assumption that a single-phase alternating flux can be resolved into two equal superimposed constant-magnitude fluxes, revolving at equal speeds in opposite directions, and consequently that the single-phase squirrel-cage motor could be represented by two similar direct-coupled polyphase mo-

Directions for ordering papers on page 178

LimiTorque
assures safe, trouble-free valve operation



...at Elrama Power Station, Duquesne Light Company

The LimiTorque Motorized Valve Operator shown above is mounted on a 12″ - 1500# Powell Gate Valve which is used as a Stop Valve on the #1 boiler steam lead at the Duquesne Light Company's Elrama Power Station . . . The Elrama #1 Unit is rated at 100,000 kw capability with steam at 1250 psi and 950° F. This is but one of many LimiTorque Motorized Valve Operators used by Duquesne Light Company in their various Power Generating Stations.

Thousands of LimiTorque Operators are used in Power Plants and Generating Stations throughout the world, which is proof-positive of their absolute dependability, safety, operating economy, and long service life.

Wherever automatic, remote valve operation is required, LimiTorque will provide rapid, precise control under a wide range of operating conditions. Actuated by electricity, hydraulic pressure, air, or high pressure gas, LimiTorque can be readily field mounted on existing valves. For specific applications, contact your valve manufacturer or nearest LimiTorque representative.

LIMITORQUE CONTROL

Be sure to send for our complete catalog L-550 which illustrates and describes the construction, operation and installation of LIMITORQUE.

THERE IS NO SUBSTITUTE FOR —

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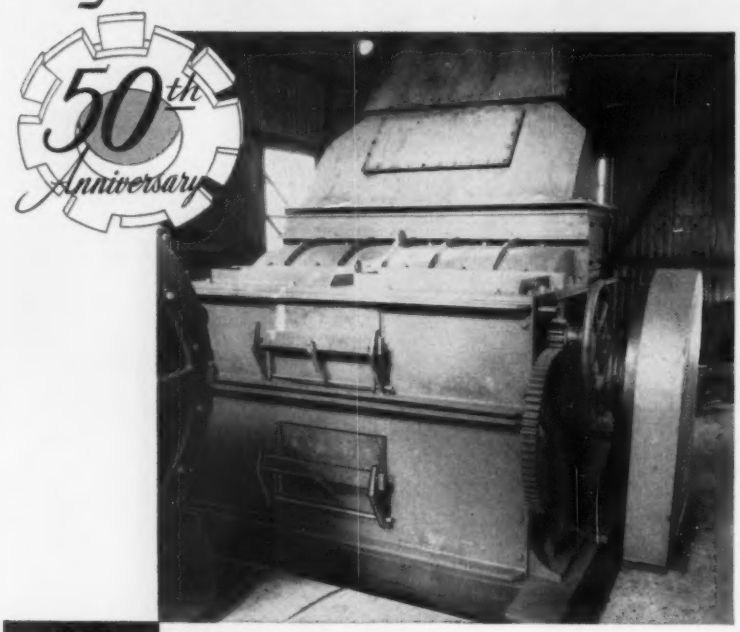
CRUSHING FACTS

from *American* PULVERIZER CO.



USER REPORTS

"We've reduced 2,521,000 tons of 2" N & S coal to a ¾" product. Crusher has given satisfactory service. Rings and screens have been renewed only once."

Replacement parts on this American AC-7C Rolling Ring Crusher after crushing 2½ million tons of coal have cost only $0.0016 per ton (1/6th of a cent).

There's good reason for performance records like this. The American originated rolling shredder ring efficiently splits coal instead of crushing it. Coal spends less time in the crusher; therefore, there is less attrition in the crushing chamber and less wear on the screens. Further, the rings are reversible for double wear. In addition, the effectiveness of the crushing elements permit slower operation speeds.

Our engineers will analyze your reduction problem. No obligation to you.

American PULVERIZER COMPANY
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1349 MACKLIND AVE. ST. LOUIS 10, MO.

Technical briefs

Begins on page 134

tors excited for opposite rotation.

This theory results in complications that make it difficult to understand, similar to the situation that would develop if it was attempted to represent the single-phase transformer as two similar polyphase transformers connected with opposite sequences to a common load.

The paper goes on to present the author's position, and his comments on Alger's paper, "The dilemma of single-phase induction-motor theory," above. *AIEE paper, No. 58-940*

Calculation of induction-motor torque and power. *By W H Middendorf, University of Cincinnati*

This paper shows the derivation of an equation which gives induction motor torque as a function of applied voltage with complete theoretical accuracy. The derivation is made possible by the discovery of a simple relation between the load current of equivalent right- and left-hand L networks. The exact equation is simplified by neglecting certain insignificant terms. The resulting equation is then found to yield relations for the slip at which maximum developed torque occurs, and maximum developed torque, which gives numerical results with negligible error.

Similar improvements are made in the equation for maximum developed power and the slip at which maximum developed power occurs. These equations allow the engineer to determine important values of torque and power accurately and conveniently. *AIEE paper, No. 58-778*

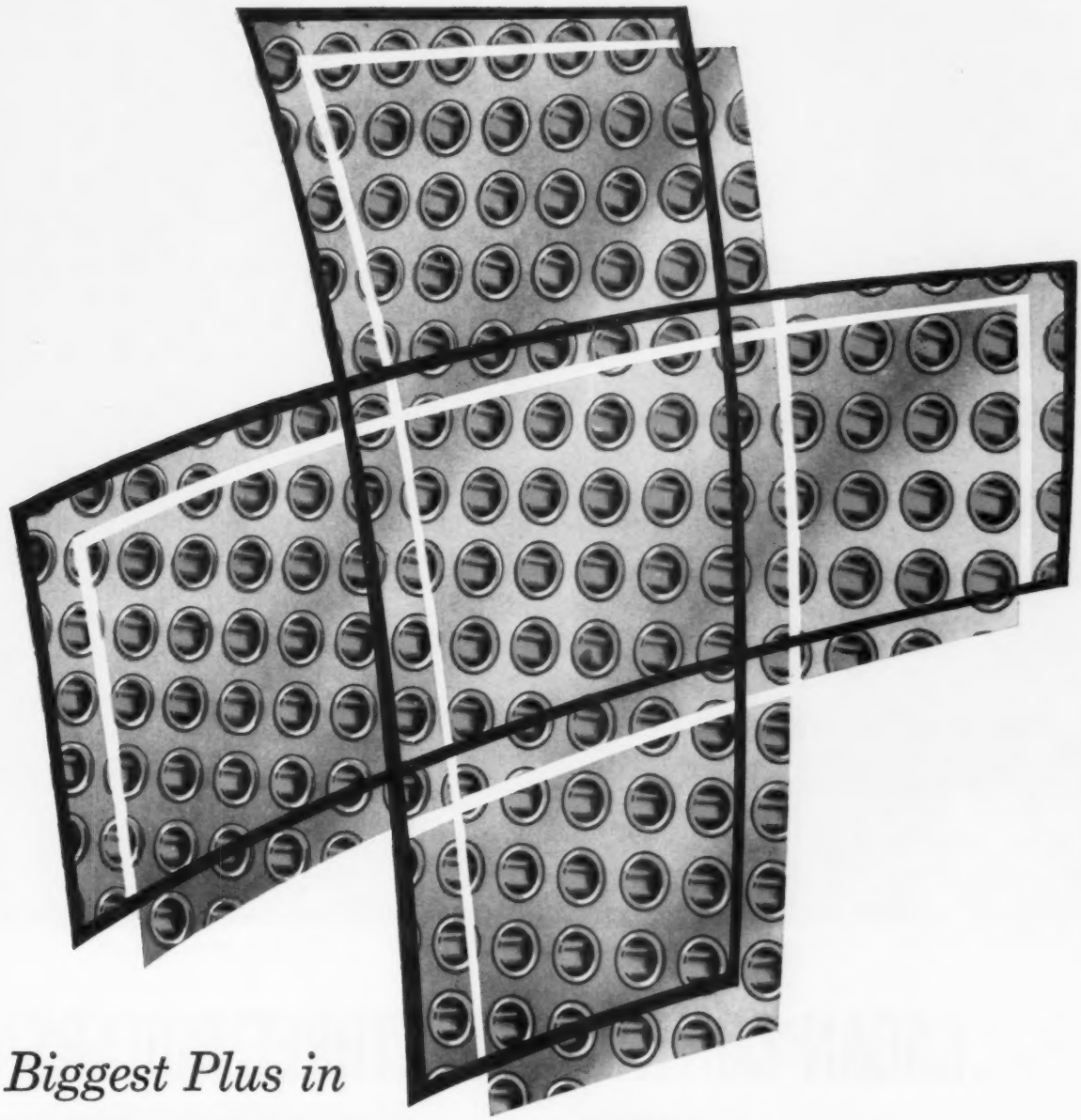
Sources of electromagnetic vibration in single-phase induction motors. *By L W Magyar, General Motors Corp*

The importance of keeping close tolerances in machining and processing induction-motor parts is pointed out by the great influence dissymmetries have on noise generation. The random character of rotor conductivity and permeance distribution make probable the generation of force waves that result in multiple slip-frequency beat.

In a motor with even number of

(*Continued on page* 174)

Directions for ordering papers on page 178



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CONDENSER TUBE *life*...CHASE® *dependability!*

Dependability is more than just a word with Chase. It's a reality! Or, rather, one hundred and twenty million pounds of reality. That's roughly how much Chase Antimonial Admiralty has been put into service since 1935. What does it mean? Simply this: superior corrosion resistance under adverse conditions... far fewer equipment breakdowns...extra years of money-saving service. Each a profitable plus! See! Today write for your free 54-page manual: *"Chase Condenser and Heat Exchanger Tubes."*

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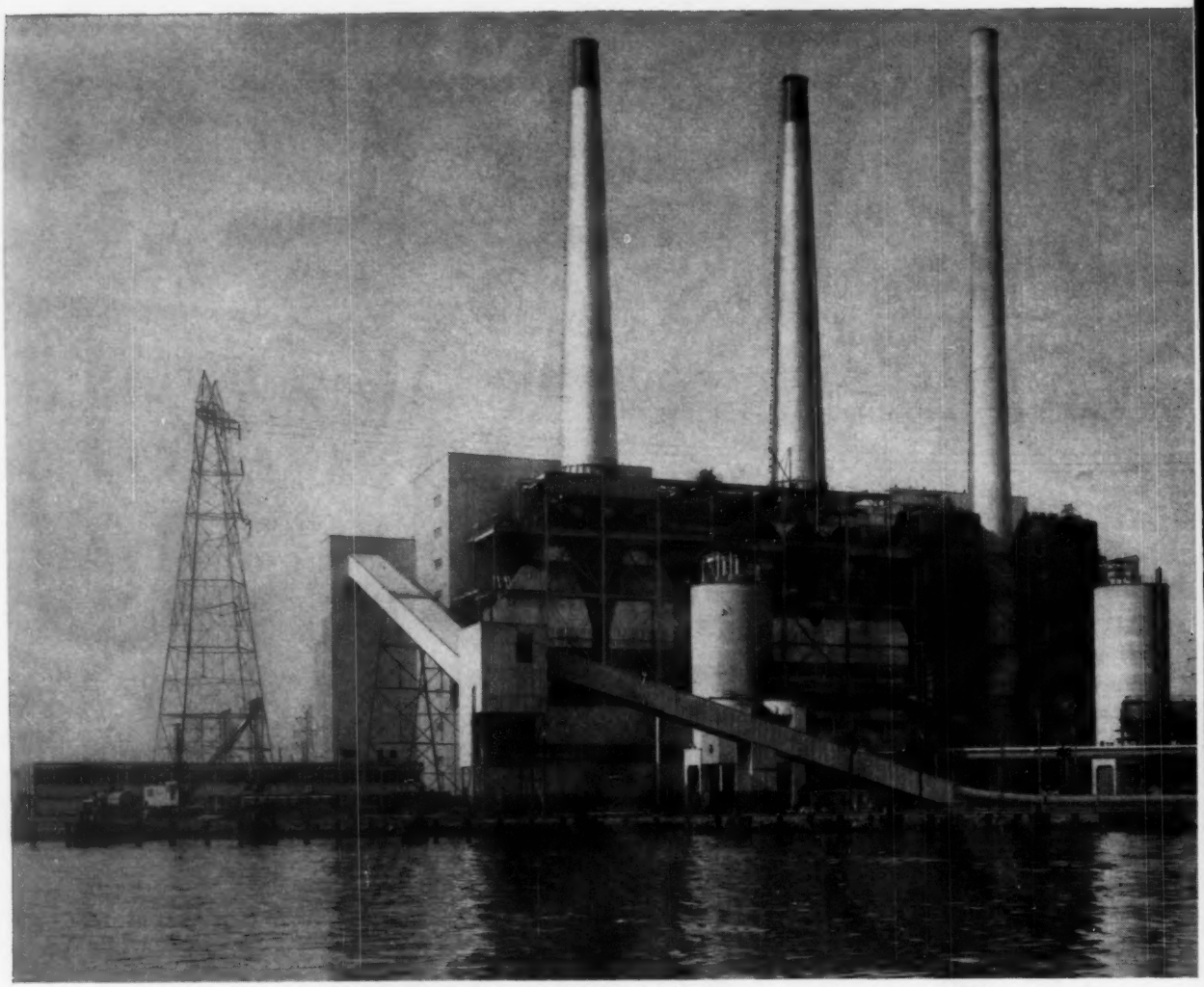
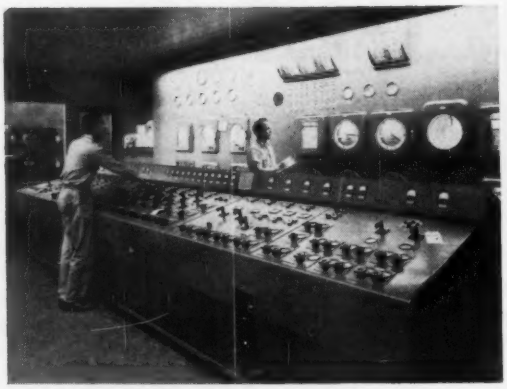
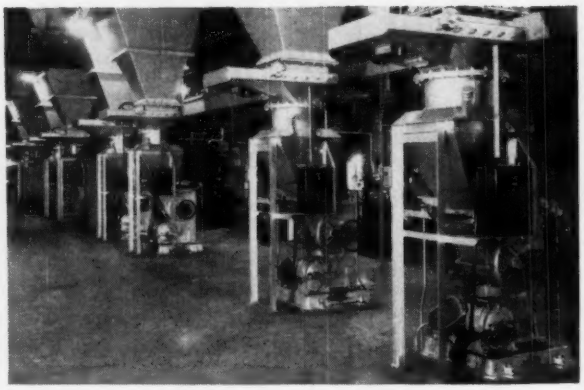


Detroit Edison Company's River Rouge plant. Combustion control system uses the Hagan Master Sender as the basic unit.

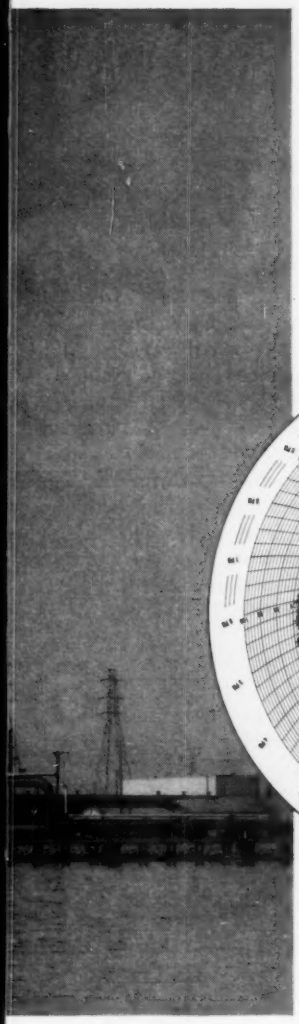
HAGAN CONTROLS ALL THREE BOILERS



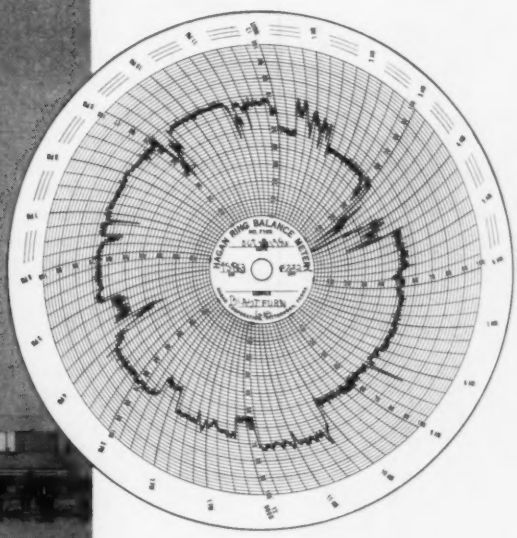
Control panel and Console at the River Rouge plant. Close check on all phases of station operation is facilitated by the high accuracy of the Hagan Ring Balance meters.



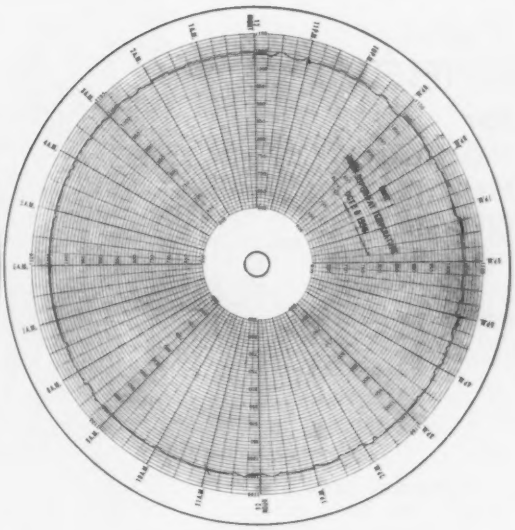
Main firing aisle. Here Hagan Power Positioners regulate the flow of pulverized coal to meet steam demand accurately and dependably.



BLAST FURNACE GAS



MAIN SUPERHEAT TEMPERATURE



This comparison of Blast Furnace gas flow and Main Superheat Temperature shows how closely Hagan control maintained the set point, regardless of the fact that BF gas flow fell to zero almost instantaneously at one point. Note the suppressed range of the superheat temperature chart (600°F-1000°F), each division is only 10°.

AT DETROIT EDISON'S RIVER ROUGE PLANT

Detroit Edison Company's River Rouge plant easily qualifies as one of the nation's largest steam generating plants. It has three huge twin-furnace boilers, each made by a different manufacturer. *But all three boilers* are equipped with Hagan Combustion Control, Hagan Steam Temperature Control, Hagan 3-Element Feedwater Control and Hagan metering.

Fuels used are pulverized coal and blast furnace gas from a nearby steel mill. In spite of wide and sudden variations in the flow of BF gas, steam temperature and header pressure are held within established close limits. Steam temperature control includes flue gas recirculation and attemperation for unit #1; burner tilt and attemperation for unit #2; firing split control with a heat-exchange type attemperator for unit #3.

Hagan 3-element feedwater control system has proven advantageous during startup, blowdown, and shutdown periods. Fully compensated for variations in pressure and temperature, the Hagan system permits maintenance of accurate automatic control over a wide range of operating conditions.

Hagan's experience with the design and construction of control systems for every type of boiler, plus leadership in the exact control of multiple fuel firing, was a valuable asset in building the River Rouge systems. Hagan's highly qualified field engineers also contributed to the rapid and successful completion of this unusual installation.

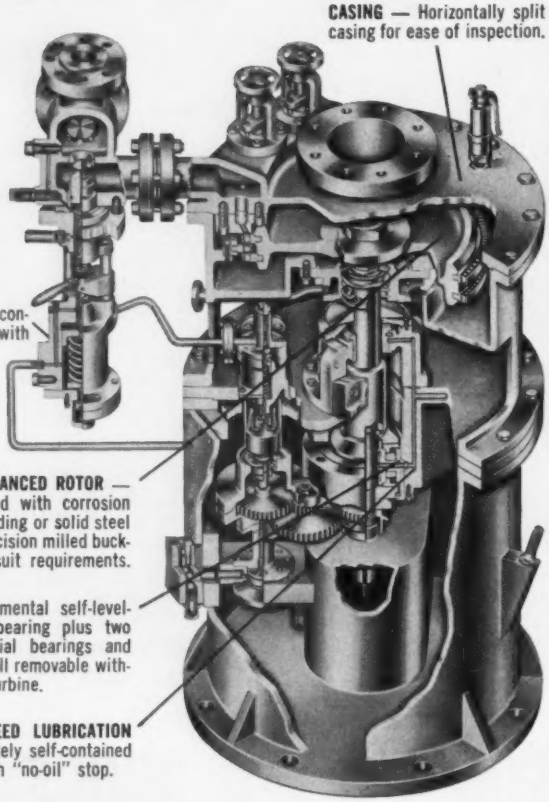
Hagan skills and experience are available to you. A letter or phone call will bring complete information, or a Hagan engineer will be glad to discuss your particular problem.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

NEW Whiton VERTICAL TURBINE

Type BHBSV for Vertical Pump Drives



CASING — Horizontally split casing for ease of inspection.

SPEED CONTROL — Oil constant speed governor with overspeed stop.

DYNAMICALLY BALANCED ROTOR — Either steel forged with corrosion resistant steel blading or solid steel one piece with precision milled buckets available to suit requirements.

BEARINGS — Segmental self-leveling type thrust bearing plus two babbitt lined radial bearings and shaft packing — all removable without dismantling turbine.

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Technical briefs

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stator and rotor slots, the first order force wave, responsible for bearing rattle and vibrations by bending the rotor shaft, is always a result of manufacturing imperfections.

All higher frequency vibrations, which are not multiples of line frequency, are the results of rotor dissymmetries. A wave chart based on the derived equations can be constructed to facilitate the closer tracing of noise sources.

By testing rotors under actual operating conditions, and measuring the dissymmetry level by a pickup voltage, potentially noisy rotors can be located. These rotors may also be the cause of poor performance. *AIEE paper, No. CP-58-849*

Lubrication

Radioactive tracers in extreme-pressure lubrication. *By E H Loeser, R C Wiquist and S B Twiss, Chrysler Corp*

Extreme-pressure lubricant additives have been used for about 30 years to prevent scuffing (catastrophic wear) in applications of high unit loading, such as found in hypoid gears. The trend in modern engine design has necessitated use of mild extreme-pressure (EP) additives in lubricants to prevent scuffing the cams and tappets in valve trains, even though the mechanism of film formation is not fully understood. To make continued advances in EP lubrication, more should be known about the mechanism of EP film formation.

The authors reviewed recent literature on radioactive tracers. They found that radioactive tracers have been successfully applied in the study of physical and chemical surface films. The radioactive tracers are usually incorporated in the film-forming additive or compound. In the studies reviewed, the radioactive tracers were used to determine: (1) the quantity of one or more of the components in the adsorbed film (2) the location of a component on a surface (3) the rate of film formation or depletion in static or dynamic tests under controlled conditions, such as surface material, temperature, load

Directions for ordering papers on page 178

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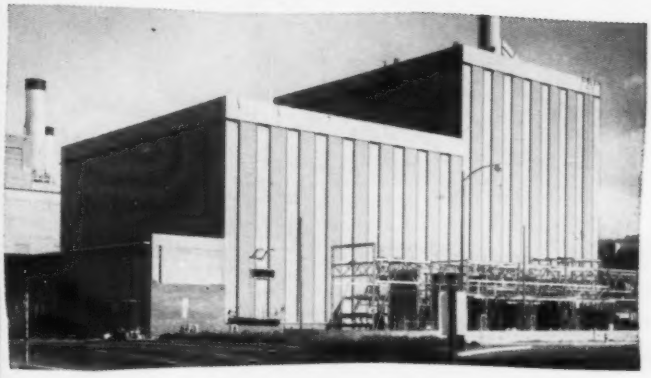

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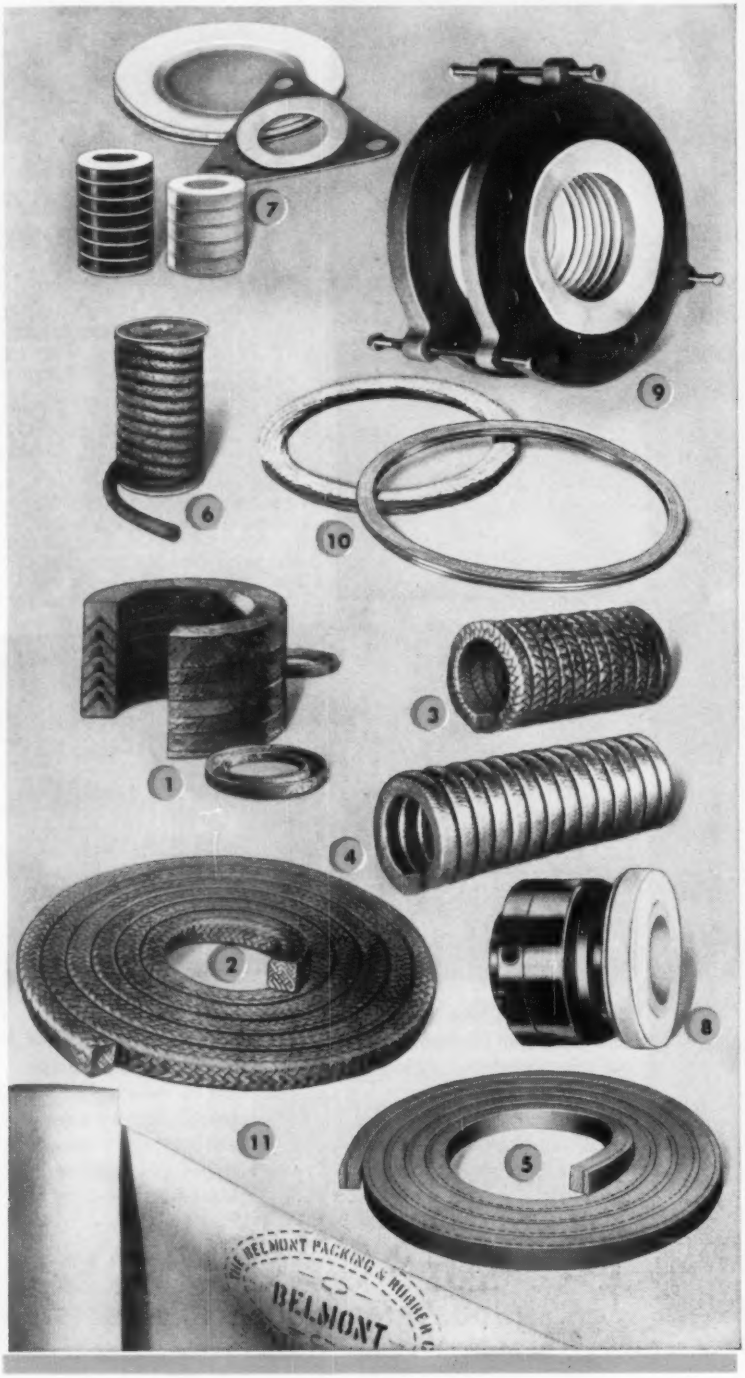

Technical briefs

Begins on page 134

and speed (4) the loss of film after physical or chemical treatments, such as solvent extraction, evacuation, or abrasion (5) the penetration of film components into a metal surface.

The initial study of the EP additive zinc dialkyl dithiophosphate, using radioactive phosphorus-32, presented in this paper demonstrated that (1) a chemical film is formed on the surface (2) the amount of bound phosphorus depends on the surface treatment and increases with time and temperature until equilibrium is reached (3) the dynamic test conditions greatly increase the amount of bound phosphorus in the film, indicating that surface temperature, pressure or wear has a marked effect on film formation (4) the quantity of bound phosphorus in dynamic tests increases with load and speed and (5) the amount of bound zinc (X-ray spectrometer determination) in the static tests increases as a function of temperature but not as rapidly as bound phosphorus. *NESC paper, No. 70.*

Computers

An application of the digital computer to steam-turbine testing. *By R G Schuerger, Cleveland Electric Illuminating Co*

This paper describes the digital-computer technique used to calculate results of the performance test of a large steam turbine-generator unit (No. 4 at the Eastlake Plant of Cleveland Electric Illuminating Co). They felt that using a digital computer for these calculations would (1) reduce the time lag between running the test in the field and developing final results (2) save man-hours devoted to computation (3) eliminate random human errors (4) provide valuable experience in the techniques of using digital computers.

Computer accuracy is at least equal to that of manual calculation since the same basic principles and procedures are followed. And, since many chances for human error are eliminated, accuracy can easily be better.

The company used an *IBM-650*

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computer—a magnetic-drum digital computer with decimal input and output. Because of the length of their particular test calculation, they had to process each test run in two passes through the computer. Pass 1 calculated enthalpies of steam and water as a function of temperature and pressure. Pass 2 computed flows, heat balances, heat rates, efficiencies, etc, using information developed in the first pass. *APC paper, No number*

Application of an automatic digital data-collecting system to the Philo supercritical unit. *By H T Hoffman, Bailey Meter Co, and A S Grimes, American Gas & Electric Service Corp*

Paper describes an approach to the application of automatic digital data-taking equipment to turbine-cycle testing. The work described is part of a program studying the problem of automatically testing central-station turbine-generator units. This phase of the program was aimed at establishing techniques for testing turbine cycles with a minimum of manpower. Raw data is collected automatically, and calculations are performed on a digital computer.

The data-collecting equipment used is an experimental system called *Datak*, built jointly by the Bailey Meter Co and Babcock & Wilcox Co. Output of *Datak* is a punched paper tape in teletype code containing the cycle data and test-identification information. The paper tape transmits this data to a remote digital computer via teletype, where the appropriate cycle calculations are made and the results transmitted back to the test location. The test crew is advised of the success or failure of a particular test a few hours after completion.

The authors feel that the general techniques used in this investigation have considerable promise for general use, particularly on the larger units now being built. They expect that digital data-collecting equipment and associated digital computers will play an increasingly important role in operation of central-station electrical generating units. The equipment will find use in areas of optimizing operating procedures, incremen-

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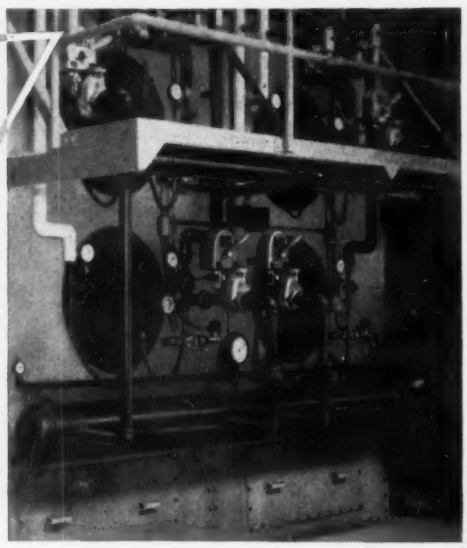

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Technical briefs

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tal loading, maintenance evaluation, and undoubtedly others. *APC paper, No number*

Automation

Automation progress in the United States. *By L D Miller, Automation Magazine*

Practical industrial automation progress in our country is reflected in developments in the concept, its acceptance, techniques, and hardware. Evolution of progressive steps in these areas has brought us to our present industrial scene. This paper describes some of the features of this scene and uses examples from American industry to illustrate developments. *ASME paper, No. 58-SA-52*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

American Power Conference, 20th anniversary meeting. Identified by initials APC and available from Director, APC, Illinois Institute of Technology, Chicago 16, Ill.

Nuclear Engineering & Science Conference, Chicago, Ill. Identified by initials NESC. Available from American Institute of Chemical Engineers, 25 W 45th St, New York 36, New York.

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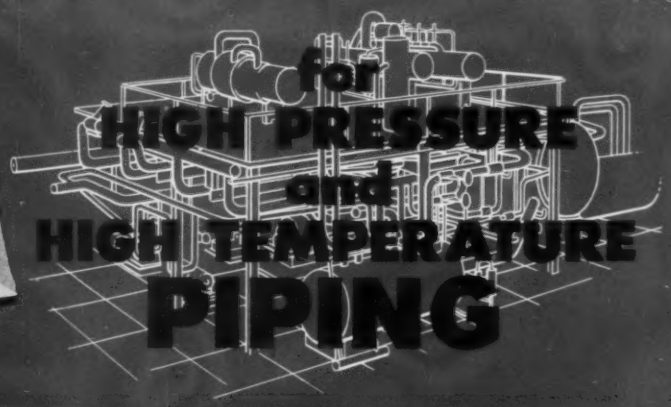

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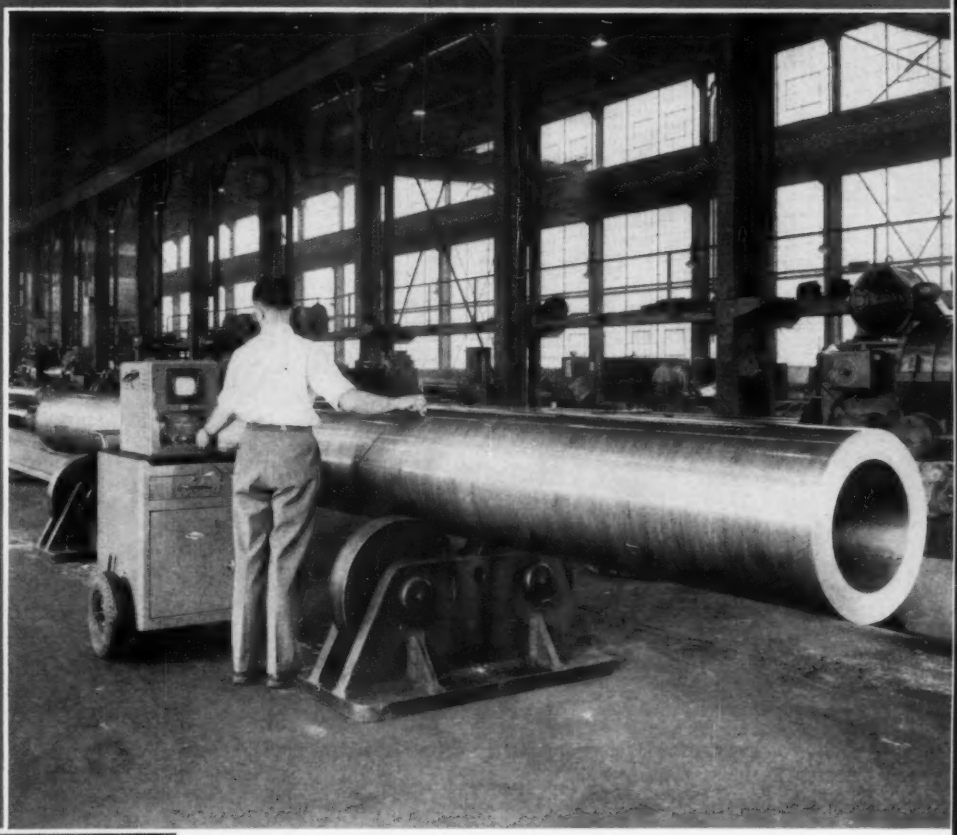

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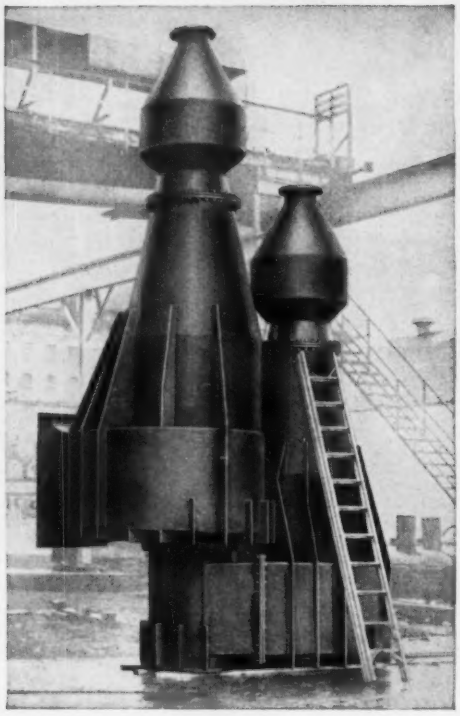

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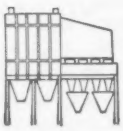

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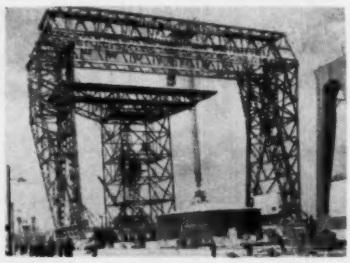
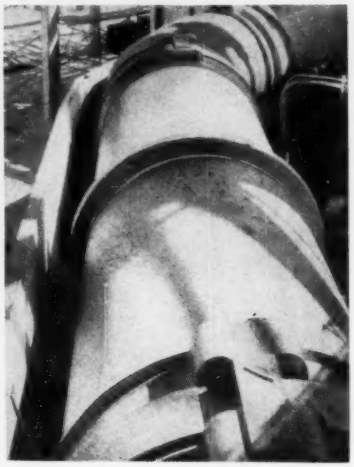


Meet Goliath: he's 185 ft high

A giant crane is being used in the construction of a nuclear power station at Bradwell, Essex, England. Crane is named Goliath, and is probably the largest of its type in the world. Nearly 700 long tons of steel and 13,000 nuts and bolts were used to make it, and it cost $1,120,000 to install at the site.



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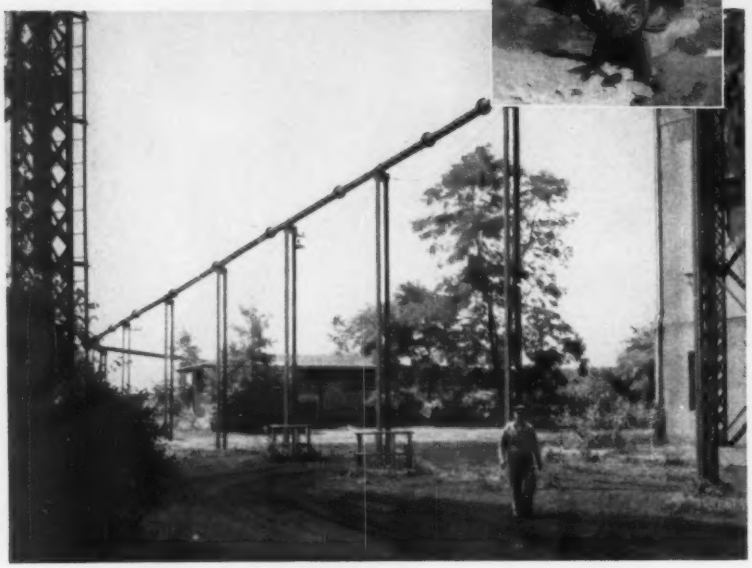

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Reports from the field

Begins on page 132

joints with curvilinear corrugation design. Design is based on a correlation between shape, height and pitch of corrugations. The all-curve shape of the corrugation should result in lower flexing stresses and increased flexibility.

Calendar of Events

Sept 7-11—World Power Conference. Queen Elizabeth Hotel, Montreal. Details from Editorial Assoc Ltd, Suite 220, 1255 University St, Montreal, Quebec, Canada.

Sept 15-17—American Institute of Electrical Engineers, Power-Industry Computer-Application Conference. King Edward Hotel, Toronto. Details: J R Leslie, Ontario Hydro, 620 University Ave, Toronto 2, Ontario, Canada.

Sept 15-17—American Society of Mechanical Engineers, Process-Industries Conference. Statler Hotel, Buffalo, N. Y. Details from ASME, 29 W 39th St, New York 18, N. Y.

Sept 15-19—Instrument Society of America, 13th Annual Instrument-Automation Conference and Exhibit. Philadelphia Convention Hall, Philadelphia, Pa. Details from F J Tabery, 3443 S Hill St, Los Angeles 7, Calif.

Sept 22-24 — Standards Engineers Society, 7th Annual Meeting. Benjamin Franklin Hotel, Philadelphia, Pa. Details from SES, Box 281, Camden 1, N. J.

Sept 28-Oct 1—American Society of Mechanical Engineers, Power Conference. Statler Hotel, Boston, Mass. Details: ASME, 29 W 39th St, New York 18, N. Y.

Sept 29-Oct 3—American Society of Tool Engineers, Semi-Annual Meeting and Western Tool Show. Shrine Exposition Hall, Los Angeles, Calif. Details: ASTE, 10700 Puritan Ave, Detroit 38, Mich.

Oct 9-10—American Society of Mechanical Engineers and **American Institute of Mining and**

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Walworth Pressure-Seal Valves are available in 600, 900, 1500 and 2500 Lb ratings, ASA B16.5 – 1957, and in a wide range of sizes and types. Complete information is available from your nearby Walworth Distributor – or – write Walworth for a free copy of Circular 16.

and including these valves for "*'round-the-plant*" use!

WALWORTH SMALL CAST STEEL Y-GLOBE VALVES. Simplified design eliminates many of the problems encountered in high-temperature, high-pressure service. No bonnet joint. Improved back-seat design means longer life for packing rings.

WALWORTH LUBRICATED PLUG VALUES. Easy turning—quick operating. Lubricant can be renewed while the valve is in service. Lubricant completely surrounds the plug ports for a tight seal against leaks. Remember, always use Walworth Lubricant in Walworth Lubricated Plug Valves.

WALWORTH BRONZE VALVES. Standardized lines of bronze valves provide an unsurpassed system of interchangeability of parts, drastically reducing inventory problems. Walseal Valves with brazing ends also available in a variety of types.

WALWORTH IRON BODY GATE VALVES. Straight-flow port design reduces fluid turbulence to a practical minimum. Seat rings of end-seated type are screwed into the body. Brass liner on glands assures greater resistance to corrosion and scoring. Available with threaded or flanged ends.

WALWORTH CAST STEEL GATE VALVES. Bolted bonnet, wedge gate, OS&Y. Bonnets and bodies are engineered to withstand pressure and minimize distortion. Heavy steel walls provide extra strength and longer life. Deep stuffing boxes in all sizes (2" to 24") insure tightness and maximum packing life. Also available in globe and angle types.

WALWORTH

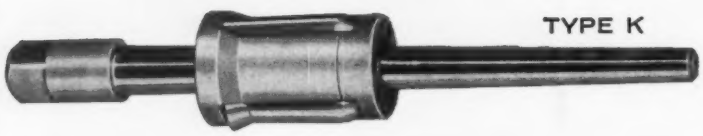
750 THIRD AVENUE, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WALWORTH SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO. M&H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING & WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

write for your copy of this Bulletin!

ELLIOTT
Boiler Tube Expanders
for tubes 3/4 in. I.D. and up



This 16-page bulletin describes general types of Elliott boiler tube expanders for fast, efficient tube rolling jobs. It also gives dimensions, prices and other descriptive data and shows various drum, header and short series mandrels which are used with Elliott boiler tube expanders. Drum mandrels are seen with Type M and Type K above.

Accessories available to adapt Elliott boiler tube expanders to various tube rolling applications include universal joints and extension shafts, sockets, gear drives, etc. A new heavy-duty, right-angle gear drive utilizes roller bearings to minimize friction, cutting down power losses.

RIGHT-ANGLE GEAR DRIVE▸
Available in ½, ¾ and 1-in. sizes

Write the Elliott Company, Lagonda Division, Springfield, Ohio, *today*, for your copy of Bulletin Y-46.

Y7-5

ELLIOTT Company
For Tube Cleaners, Expanders and Accessories

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

Reports from the field

Begins on page 132

Metallurgical Engineers, Fuels Conference. Old Point Comfort Hotel, Old Point Comfort, Va. Details: ASME, 29 W 39th St, New York 18, N. Y.

Oct 13-15—American Society of Mechanical Engineers and **American Society of Lubrication Engineers,** Lubrication Conference. Statler Hotel, Los Angeles, Calif. Details from R B Purdy, Socony Mobil Oil Co, 150 E 42nd St, New York, N. Y.

Oct 13-17—American Society of Civil Engineers, Civil Engineering Show, in conjunction with the Annual Convention. Hotel Statler, New York. Details: ASCE, 33 W 39th St, New York 18, N. Y.

Oct 15-17 — Natural Resources Council of Denver Chamber of Commerce, Second Energy Resources Conference. Brown Palace Hotel, Denver. Details from Denver Chamber of Commerce, 1301 Welton St, Denver 4, Colo.

Oct 27-31—American Society for Metals, National Metal Exposition and Congress. Cleveland Public Auditorium. Details from ASM, 7301 Euclid Ave, Cleveland 3, Ohio.

Oct 29-30 — Armour Research Foundation, Computer Applications Symposium. Morrison Hotel, Chicago. Details from Armour Research Foundation, Chicago, Ill.

Nov 4-5—Industrial Management Society, Seminar on Executive Techniques for Industrial Engineering. **Nov 6-7**—22nd Annual National Industrial Engineering and Management Clinic. Sherman Hotel, Chicago. Details from IMS, 330 S Wells St, Chicago 6, Ill.

Nov 18-20—American Standards Assn, Annual Meeting. Roosevelt Hotel, N. Y. C. Details: ASA, 70 E 45th St, New York, N. Y.

Nov 30-Dec 5—American Society of Mechanical Engineers, Annual Meeting. Statler and Sheraton-McAlpin Hotels, N. Y. C. Details from ASME, 29 W 39th St, New York 18, N. Y.

compressor-user survey shows

FEATHER VALVE PREFERRED 2 TO 1!

FEATHER VALVE

VALVE A

VALVE B

A recent survey of compressor users put the amazing Feather* Valve first by far in all four operating categories —simplicity of construction, efficiency, low maintenance cost and quiet operation. In addition, the Feather Valve was picked as the preferred compressor valve 2 to 1 over the nearest competing type of valve!

The lightest, fastest-acting valve available, the amazing Feather Valve provides very sharp action with virtually no slip or back-flow. It works with no impact . . . has no buffer plates or cushioning devices. Practically indestructible it assures long life with negligible maintenance costs. When buying your next compressor, look into Worthington's complete line of Feather Valve units. Worthington Corporation, Harrison, N. J.

*REG. U. S. PAT. OFF.

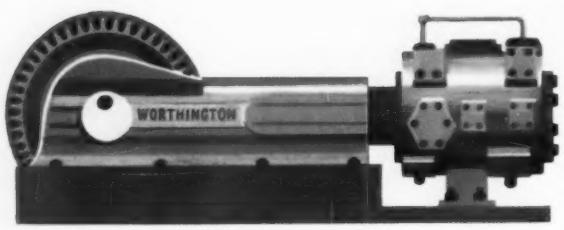
WORTHINGTON

NO COMPROMISES

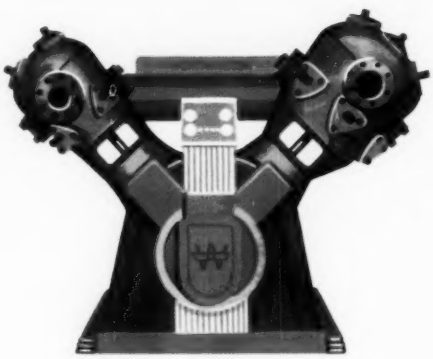
when you select from Worthington's complete compressor line

The Worthington line includes a compressor and drive for *every* compression job. Sizes range up to 10,000 hp and gas pressures to 35,000 psi. In addition to the types shown below, Worthington builds many others including steam engine, steam turbine, and engine driven machines in many types and sizes. For more information write specifying the bulletin noted below to Worthington Corporation, Section 36.1, Harrison, N. J. In Canada: Worthington Canada Ltd., Brantford, Ont.

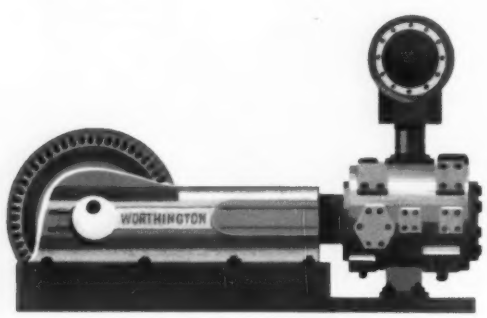
WORTHINGTON



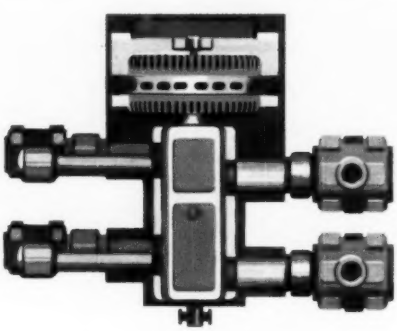
Single horizontal compressor, type HB
5 to 150 hp—Bulletin L-640-B1E



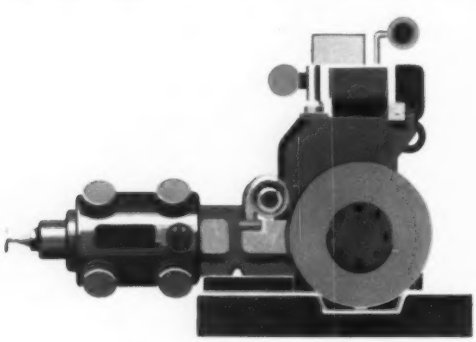
Vertical angle compressor, type YC & DYC
75 to 500 hp—Bulletin L-676-B1A



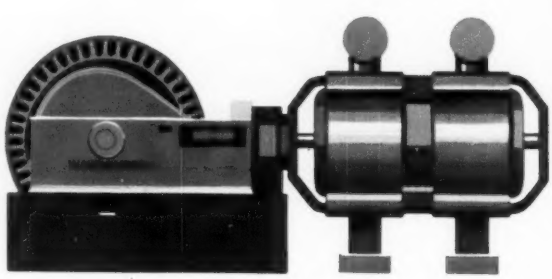
Horizontal duplex compressor, type DC
250 to 3,000 hp—Bulletin L-675-B1C



Balanced opposed compressor, type BDC
400 to 10,000 hp—Bulletin L-679-B1A

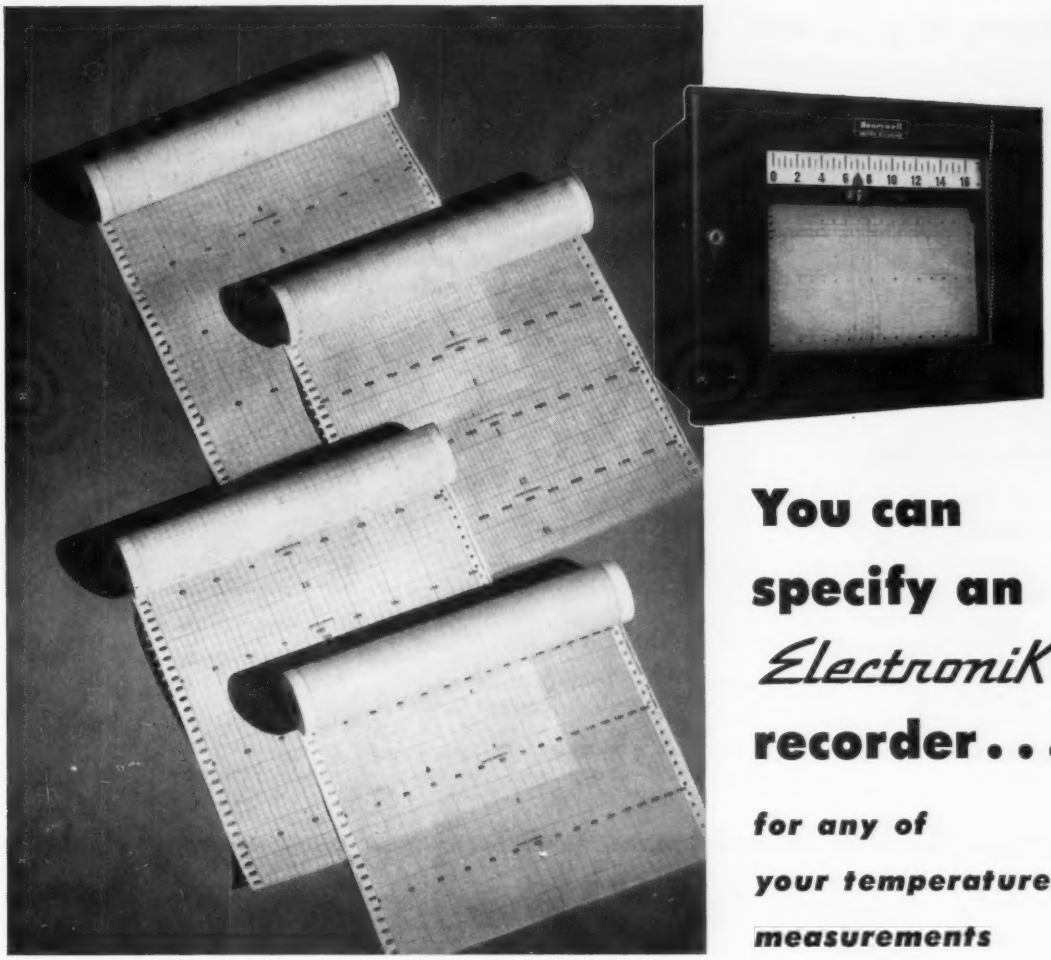


Angle gas-engine compressors, types SLHC and SUTC
375 to 2,500 hp—Bulletin S-550-B27; S-550-B23D



Vacuum pump, 200 to 150,000 CFM—Bulletin L-600-B9-4

was picked as the preferred compressor valve 2 to 1 over



You can specify an *ElectroniK* recorder . . .

for any of your temperature measurements

LET *ElectroniK* recorders keep constant watch over your plant temperatures — accurately, efficiently.

Choose one *ElectroniK* instrument to record a single temperature, or another to combine as many as twenty temperature records on a single chart. When several temperatures are combined on one chart, correlation is simple . . . operators can keep close check on trends . . . engineers can analyze operation in accurate detail.

Built-in circuits adapt these recorders for signalling excess temperatures. And there's a complete Honeywell line of thermocouples, extension wires, and power-plant-type resistance thermometers to work with *ElectroniK* instruments.

ElectroniK instruments are famous for their stamina and dependability. For a discussion of how they can be applied to measuring your plant temperatures, call your local Honeywell field engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

First in Control

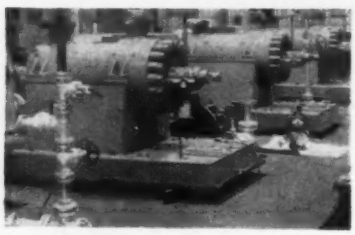
More **Reports from the field**

Tiny nuclear fuel pellets will power an atomic plant

Hundreds of these pellets, arranged in the proper pattern and quantity, make up an atomic fuel which will generate and sustain the nuclear-fission process in atomic reactors.

The ceramic pellets will be used in a reactor for an 11,500-kw plant which Westinghouse Electric Corp is building for the Belgian government.

First step in producing the pellets is mixing a slurry of uranium oxide and organic binders. Ingredients are blended in a king-sized electric mixer. Slurry is dried, and powder is fed into an automatic press that squeezes it into "preforms." These are baked in a high-temperature sintering furnace. Then the pellets are ground to tolerances less than 1/1000 of an inch, checked, photo above, and packed and shipped.



These three feed pumps are auxiliary equipment

Barrel type boiler feed pumps went into operation recently at Commonwealth Edison Co's Fisk Station, Chicago, as part of the auxiliary equipment for a new 305,000-kw turbine-generator. De Laval Steam Turbine Co made the 8-stage double-case high-pressure units. The pumps handle 1.3 million lb per hr of feedwater at 2280 psig, 343 F.

EBWR wings its way to Geneva conference

A demonstration model of Argonne National Lab's Experimental Boiling Water Reactor has been flown to Geneva for the Second International

45 master keys to

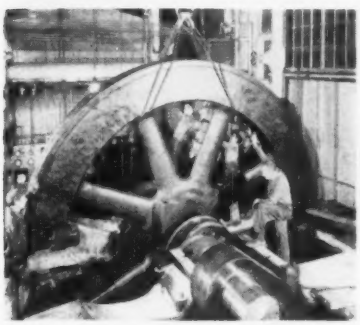
Type 302*
Type 304
Type 304L
Type 309S
Type 309Cb
Type 310
Type 316
Type 316L
Type 316Cb
*Ornamental
Type 317
Type 317L
Type 330
Type 321
Type 347
Type 348
Type 410
Type 430
Type 442
Type 443
Carpenter 7Mo (329)
Carpenter Stainless No. 20Cb
Titanium 40, 55 and 70
Zirconium
Zircalloy II & III
19-9DL & DX
Invar 36
HyMu 80
Multimet Alloy (N-155)
Haynes No. 25 (L-605)
Hastelloys B, C, F & X
Armco 15-7Mo PH
Armco 17-7PH
A-286
16-25-6
Type 201
Type 202
Low Expansion "42" and "49"

available through representatives and distributors in over

Begins on page 132

Conference on Peaceful Uses of Atomic Energy (Sept 1-13).

Components of the model weigh more than 11,000 lb. Original EBWR was one of the first "Atoms for peace" electric power plants, designed to test the value of atomic energy in helping to meet world's power needs.



Wheels of progress turn—now this wheel's retiring

For 41 years "Old No. 5," a steam-driven reciprocating ammonia compressor, served the Eastman Kodak Co's Kodak Park Works faithfully and well. No. 5, made by York Corp, is one of the largest, oldest "ice machines" in the country—but it was ultra-modern when it was installed back in 1916.

The old machine's ammonia cylinders had a 34-in. bore with a 48-in. stroke. The h-p steam cylinder had a 36-in. bore with a 48-in. stroke; the l-p cylinder a 56-in. bore and 48-in. stroke. It ran at 60 rpm. Steam at 135-psi was fed to one cylinder, exhausted to a second cylinder and then exhausted at 5 pounds to the plant's l-p steam system.

The modern successor is a multistage centrifugal refrigeration compressor, also built by York. It is only 1/3 the size of the old model, but can deliver 1200 tons of refrigeration to No. 5's 480 tons, cooling 25% calcium chloride brine from 19 to 9 F. Photo shows removal of No. 5's 37-ton flywheel.

Spain builds $50,000,000 hydroelectric project

MADRID (*McGraw-Hill World News*) Iberduero, the largest private power company in Spain, has started work on its $50,000,000 hydroelectric project of Salto de Aldeadavila. This will include a gravity dam 460-ft high, the highest in Europe of this type. In the power house, six 135,000-kva generators will supply 2-billion kwhr annually. All power equipment is to be installed underground in a rock gallery 423 ft long by 72 ft wide.

Althea Thornton leaves *Power*

After seven years as a POWER staffer, Assistant Editor Althea Thornton is leaving to teach mathematics. A graduate engineer (BME, Penn State U), Al has authored many articles in the broad field of mechanical engineering; played a key role in POWER's Modern Plant Surveys.

cost-saving corrosion control

• Whatever it takes, Carpenter makes in stainless and high alloy tubing and pipe to most effectively and economically combat most corrosive agents. On the opposite page is a wide variety of standard and special-purpose analyses that can be supplied.

What's more, you get predictable performance in all *full finished* Carpenter corrosion-resistant tubing and pipe . . . it fully meets the high quality requirements for heat exchanger service. No short-cuts . . . no false economy . . . just the kind of on-the-job service that saves you operating dollars.

You can save up to 40% in first-cost dollars by using Carpenter stainless and high alloy tubing and pipe. Their overall consistent uniformity of O.D., I.D., gauges and physical properties assures you trouble-free, time-saving fabrication and installation.

Whatever your corrosion problem . . . ordinary or unusual . . . you'll get the right answer at Carpenter—"The House of Corrosion Control". You'll benefit from over 30 years' experience in helping industries and equipment builders to solve a vast assortment of problems.

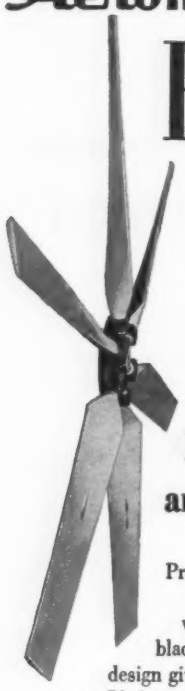
Readily available to you are data on any specific alloy you're interested in, or our Selecting and Buying Guide to your 45 master keys to cost-saving corrosion control. Contact our nearest office or authorized distributor, or write direct to The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

40 cities . . . coast to coast

stainless tubing & pipe

FAN tas tic

Aeromaster FANS



increase cooling tower efficiency with MORE CFM and LESS HP

Precision engineered Aeromaster Fans with variable pitch blades and anti-flutter design give cooling at *lower cost.* Blades resist acids, alkalies, abrasion and weather. 4, 6 or 8 blade styles in 54″ to 22′ diameters. Before you replace or consider new equipment, write: KOPPERS COMPANY, INC., 2609 Scott Street, Baltimore 3, Md.

KOPPERS Aeromaster Fans

Engineered Products Sold with *Service*

Appointments

Corporation changes

Lima Electric Motor Co, Inc: Wayne M Gideon, president. **Union Carbide Corp,** Union Carbide Nuclear Co Div: Corneille O Strother, vice-president of research. **Philadelphia Gear Corp:** S L Crawshaw, vice-president. **Garlock Packing Co of Canada, Ltd:** J B Sewell, president.

Operations changes

De Laval Steam Turbine Co, Service and Repair Div: Rear Admiral Mitchell D Matthews, USN (Ret), manager. **Foster Wheeler Corp,** Equipment Div: William A Martin, general manager. **Orr & Sembower, Inc:** Anthony J Szynkiewicz, plant manager.

Engineer changes

Aluminum Co of America: Robert N Wagner, chief electrical engineer. **City of Columbus, Ohio,** Dept of Public Safety: Richard D Schafer, chief smoke-regulation engineer. **Detroit Stoker Co:** Milton F Guy, chief engineer. **Research-Cottrell, Inc:** Ralph L Chamberlin, engineering director.

General sales manager

Chemetron Corp, Tube Turns Div: Frank S Briggs, nuclear-energy and power-plant sales. **Babcock & Wilcox Co,** Tubular Products Div: Leon B Wohlgemuth. **Alco Products, Inc:** Paul W Geisler, thermal and petroleum-industry equipment; Robert H Binkerd, industrial equipment, spring and forge div.

Cleaver-Brooks Co, Progress and Monitor Boiler Div: John Nash. **General Electric Co,** Apparatus Sales Div: John W Belanger.

District sales manager

Jeffrey Mfg Co: William Davis, Burlingame, Calif.; Elmer Longnecker, Detroit. **Brown Boveri Corp:** William Sailers, Texas; Suite 1118, Exchange Bank Bldg, 100 Exchange Pk, N, Dallas, Texas. **De Laval Steam Turbine Co:** W H Mouquin, New York.

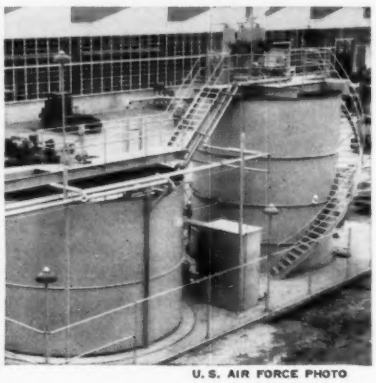
Chemetron Corp, Tube Turns Div: Jack D Tolliver, eastern region.

(*Continued on page* 194)

ILLCO-WAY ionXchange

soften
de-alkalize
clarify
WATER

REMOVE
organic matter
turbidity
color
iron



U. S. AIR FORCE PHOTO

HIGH-FLOW, UP-FLOW
CLARIFIER

The Clarifier shown above is part of an ILLCO-WAY ionXchange installation, at a metal-finishing plant, which is used for waste disposal and water recovery. Similar Clarifiers are widely employed to clear up surface waters used by various industries — removing organic matter, hardness, alkalinity, turbidity, color, and iron, as required by specific conditions.

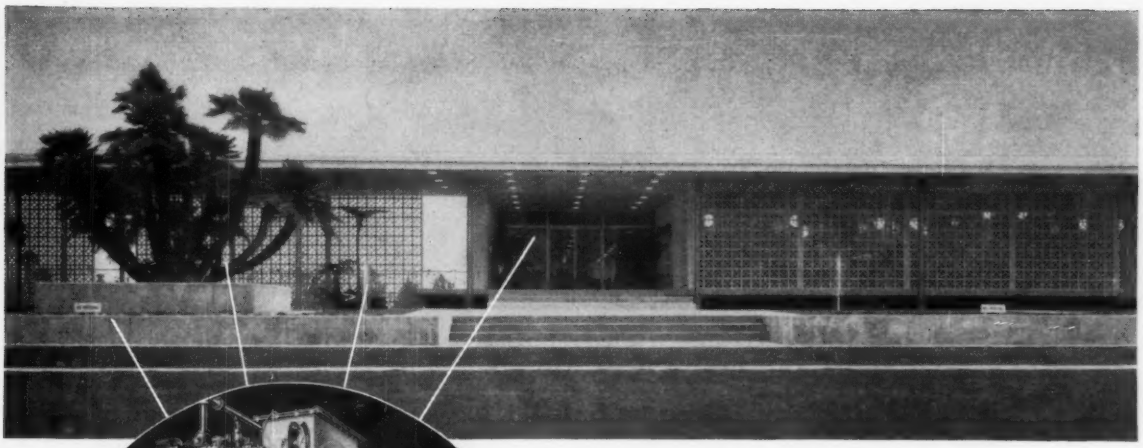
USED AS PRE-TREATMENT

In many instances it is more economical to use a Clarifier in the initial part of a system. Certain water supplies contain organic matter or turbidity which can be removed most efficiently by flocculation, or contain carbonate hardness or alkalinity which can be largely reduced by precipitation — in which situations, a Clarifier is indicated as best. *Let us analyze the water you propose to use, and advise you.*

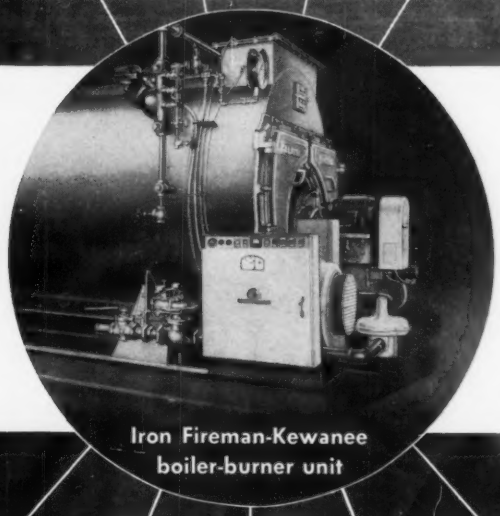
ILLCO-WAY

ILLINOIS WATER TREATMENT CO.
840 Cedar St.
Rockford, Ill.

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Can.



Screened facade of Stuart Co. plant, Pasadena, California



Iron Fireman-Kewanee boiler-burner unit

Where the *steam* comes from...

for both heating and pharmaceutical processing

One of the notable commercial buildings of the year combines maximum utility with such striking beauty that it has won nation-wide acclaim. Designed by Edward D. Stone, this plant is used by the Stuart Co. for the production of pharmaceuticals.

Up-to-the-minute mechanical equipment includes two Iron Fireman-Kewanee boiler-burner units. Due to forced draft firing, there is no stack to mar the symmetry of the building. Dual-fuel burners efficiently fire gas or any grade of light or heavy oil, with quick changeover.

Complete Iron Fireman boiler-burner units can be easily sized, specified and ordered from a single catalog, with a single model number.

Conservative rating permits an easy, economical "cruising speed" at rated output, with 50% reserve capacity and consequent minimum noise level and low maintenance costs.

Mail coupon for detailed information and specifications.

Lounge and offices overlook spacious atrium

Architect: Edward D. Stone

Mechanical Engineers: Stockly & Bamford

Mechanical Contractors: Hickman Bros., Inc.

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT FOR HEATING, PROCESSING, POWER

IRON FIREMAN MANUFACTURING CO.
3039 West 106th Street, Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send catalog and specifications on following equipment:

- ☐ Complete boiler-burner units
- ☐ Forced draft firing unit only

Name.....
Firm.....
Address.....
City.....State.....

Now! Ready-to-install in a single package—

- **High-temperature insulation**
- **A protective metal jacket**
- **A built-in vapor barrier**

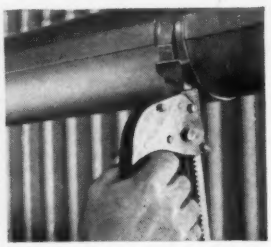
The insulation in Metal-On is Johns-Manville Thermobestos® . . . finest of all the calcium silicate insulations for service to 1200°F.

From carton to . . . with

Thermobestos calcium silicate insulation

5 SECONDS TO REMOVE Metal-On from carton. Another 25 seconds to snap on pipe and lock in place!

15 SECONDS LATER the specially designed aluminum "snap strap" (containing vapor seal) has been snapped on joint.



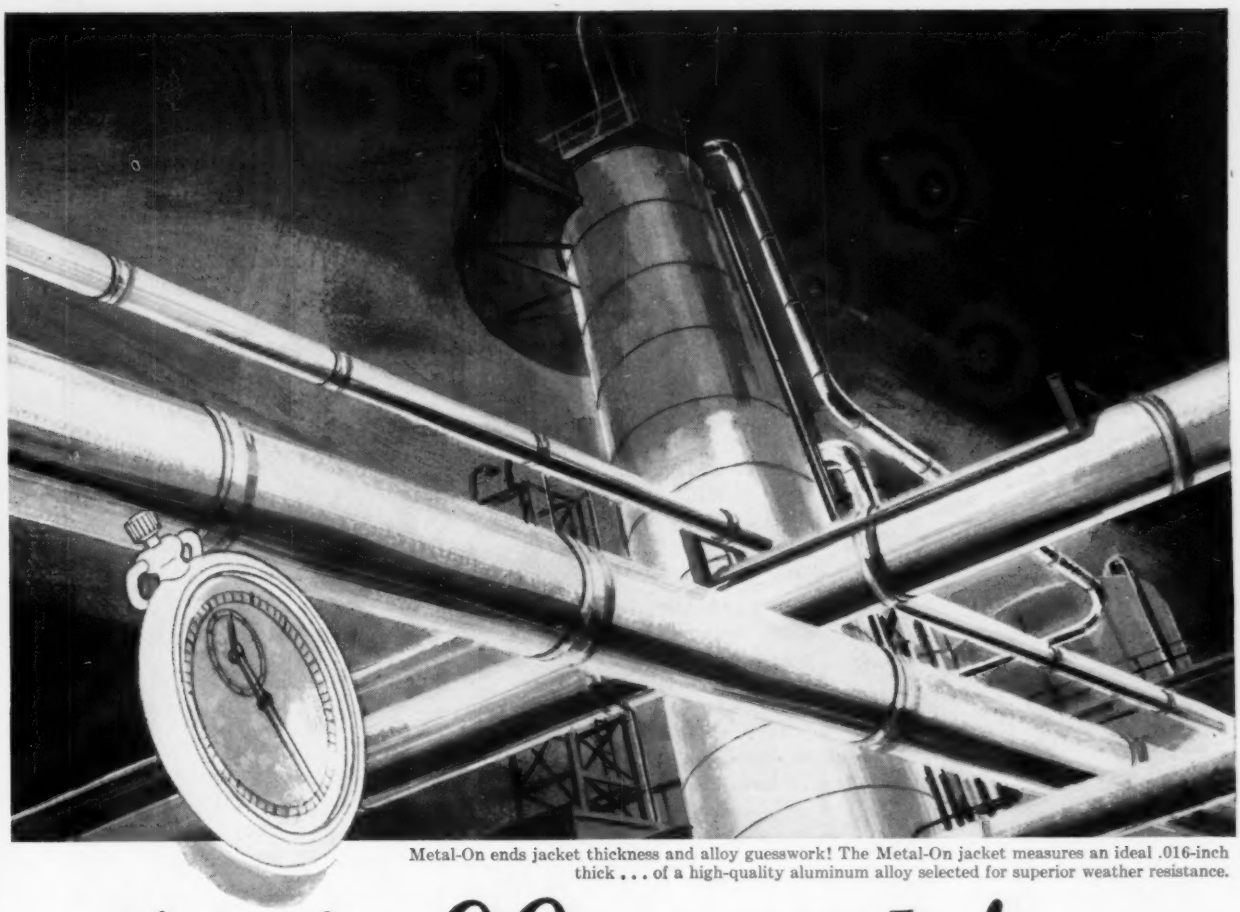
METAL BAND provides perfect joint protection against vapor and weather. Total elapsed time: 90 seconds!

Here's the fastest, most efficient way ever to install high-temperature pipe insulation and protective aluminum jacketing.

Metal-On is the insulation idea all industry has asked for: a single package product that permits application of Thermobestos pipe insulation and corrosion-resistant metal jacket in one fast operation. You'll find that a section of Metal-On can be applied as fast as, oftentimes faster than, an insulation alone.

Snaps in place . . . F-A-S-T!

J-M's new Metal-On consists of Thermobestos calcium silicate insu-



Metal-On ends jacket thickness and alloy guesswork! The Metal-On jacket measures an ideal .016-inch thick . . . of a high-quality aluminum alloy selected for superior weather resistance.

pipe in 90 seconds!

new J-M METAL-ON Insulation!

factory-jacketed in gleaming, weatherproof aluminum

lation, a vapor barrier and an all-weather protective covering of aluminum. Furnished ready-to-install, a section of Metal-On snaps on the pipe, locks tightly in place (new locking device is exclusive Metal-On feature) to seal out weather and protect the insulation indefinitely. Joints are sealed tight with aluminum "snap straps" mechanically fastened in place with metal bands.

Right alloy . . . proper thickness

The Metal-On aluminum jacket reduces maintenance in virtually every outdoor pipe application! It never needs painting . . . won't rust . . . is impervious to surface dirt, oils and grime. The jacketing is made of an aluminum alloy (containing magnesium) that is specially selected for superior corrosion resistance. Jacket thickness is designed to provide, at lowest cost, outstanding appearance, stiffness, workability and resistance to abuse and pitting.

Metal-On presents no fitting problem. It is cut easily right on the job with either power or hack saws. Available in 36″ sections in a complete range of pipe sizes through 24″ . . . by 3″ thickness.

To help you investigate Metal-On for your next pipe insulation requirement, let us send you the informative brochure, IN-217A. Write for it today. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

100 YEARS OF QUALITY PRODUCTS...1858-1958

JOHNS MANVILLE JM PRODUCTS

Uniform calibration year after year is an important bonus realized with SERV-RITE thermocouple wire. Gordon has insured this unusual accuracy by the most careful advance selection of all bare wire stock to close thermocouple specifications. From a very large stock of bare wire, wires are matched to have a minimum departure from the standard curve.

With several hundred insulation combinations applied in Gordon's own processing plant, SERV-RITE is the most complete line of thermocouple and thermocouple extension wire.

Give SERV-RITE a trial on your next thermocouple wire requirements. There's nothing better. SERV-RITE is really a premium wire at no extra cost.

Write for Bulletin No. 1200
for specifications and data on SERV-RITE Thermocouple Wire and Extension Wire.

7154

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Manufacturers • Engineers • Distributors

611 West 30th St., Chicago 16, Illinois
2023 Hamilton Ave., Cleveland 14, Ohio

Appointments

Begins on page 190

Westinghouse Electric Corp: P T Lagrone, New Orleans. **Bailey Meter Co:** R T Cathey, Dallas. **Nordberg Mfg Co,** Engine Div: Emmons L Farrell, Minneapolis.

Recent purchases

I-T-E Circuit Breaker Co: acquisition of outstanding capital stock of Canadian Porcelain Co, Ltd. **De Laval Steam Turbine Co:** exclusive agreement with W G Stoeckicht of Munich, Germany, to manufacture and sell De Laval-Stoeckicht planetary gears in the U.S. **C H Wheeler Mfg Co** and **Wayne American Co:** joint acquisition of stock of Carver Foundry, Inc.

Institute elections

American Society of Mechanical Engineers: Glenn Barton Warren, president; Charles H Coogan Jr, Gordon Rutan Hahn, John W Little, Thomas James Dolan, Harold Grasse, vice-presidents; R G Folsom, Arthur M Perrin, directors.

American Institute of Electrical Engineers: L F Hickernell, president; Lynn C Holmes, Joseph R Kerner, Robert B Gear, Ingwald T Monseth, John M Nelson, Warren H Chase, vice-presidents; William A Lewis, Norman F Rode, Eugene C Starr, directors.

Health Physics Society: Dr L S Taylor, president; Dr E E Anderson, president-elect. **National Electrical Manufacturers Assn:** J L Singleton, president.

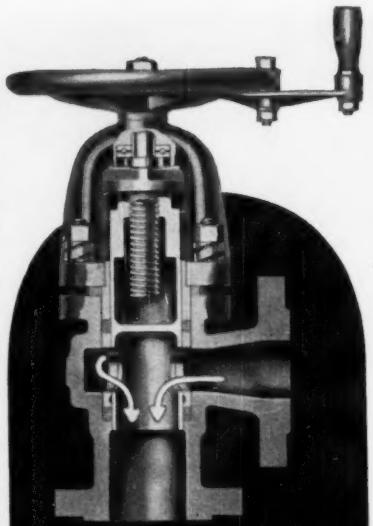
Awards

F R Owens, president, Cyrus William Rice & Co; received 5th Max Hecht Award of the American Society for Testing Materials for outstanding work in water study.

John H Nehr, senior engineer, research and development, Philadelphia; **Elmer G Norell,** partner and chief engineer, Sargent & Lundy; **James Harlow,** chief of mechanical engineering dept, Philadelphia Electric Co; Tom C Lloyd, chief electrical engineer, electrical engineering dept, Robbins & Myers Inc: made fellows of the American Institute of Electrical Engineers.

Obituaries

Philip N Engel, board chairman of



Drop-tight shut-off. No seat to score, wear, clog or leak.

YARWAY SEATLESS BLOW-OFF VALVES

the lowdown on blowdown

Over 16,000 boiler plants depend on Yarway Seatless Blow-Off Valves. Pressures to 600 psi. Single or tandem combinations. For free Blow-Off Valve Book write YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia 18, Pa.

Branches in all principal cities.

go YARWAY with confidence

Stainless-clad surface stays new—keeps coal flowing through bunker noses, hoppers

The corrosion resistant surface of Lukens clad steel *stays new*. Sliding coal actually polishes its surface, keeps it smooth. Costly hangups are cut to a minimum. And clad steel's durability in bunker noses, chutes, hoppers and spreaders is proved by installations 10 years old which show no measurable wear.

Lukens clad steel is not a lining but a solid plate —one side corrosion resistant stainless steel permanently bonded over all to a rugged backing steel.

With clad steel you are assured of ready fabrication, reduced maintenance, freedom from down time, and easy modification. And Lukens will help you and your fabricator select the proper types and gages to meet your needs.

Bulletin 740 will give you performance facts and production information. Send in the coupon and, if you wish, write for the names of experienced coal handling equipment builders. Lukens Steel Company, Coatesville, Pennsylvania.

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133 Lukens Building, Coatesville, Pa.

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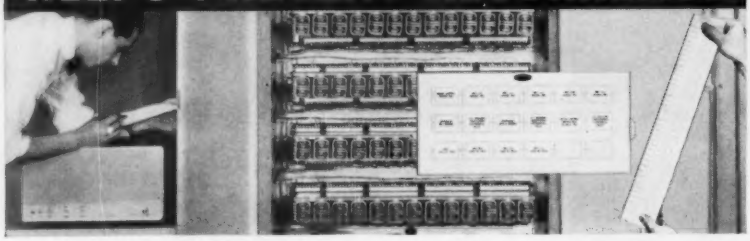
RECORDS POWER SHUTDOWNS, HELPS PREVENT RECURRENCE



New PANALARM Recording Annunciator Uncovers Profit Leaks

- **Pinpoints power station trouble spots by accurately, instantly recording off-normal and on-off operations.**
- **Permanent, unalterable statistical data helps prevent stoppage repetition.**
- **No time-wasting decoding. Directly readable digital form.**

TYPICAL APPLICATION:

The exact time period of steam stop valve closure, generator circuit breakers and overspeed trip resets is permanently recorded, providing advance notice of sluggish functioning and permitting immediate preventative action.

Earnings from lost electrical sales are gone forever. Model RA helps lessen such losses by reducing downtime, maintenance and operating costs. Write for Bulletin 102 today.

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EXTRA YEARS

OF MORE DEPENDABLE POWER

and at less cost per pound of steam

TODD BURNERS

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PRODUCTS DIVISION

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HEADQUARTERS:

Columbia & Halleck Streets, Brooklyn 31, N. Y.

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TODD NEW YORK, U.S.A.

Appointments

Begins on page 190

the firm of Infilco, Inc, on May 26.

Clayton W Work, 65, sales-promotion manager for instruments and controls div of Hagan Chemicals & Controls, Inc, on June 19.

John Frederick Straitz, production vice-president of National Airoil Burner Co.

William J Healy, 60, sales manager for De Laval Steam Turbine Co, Blower and Compressor and Turbine Div, on June 3.

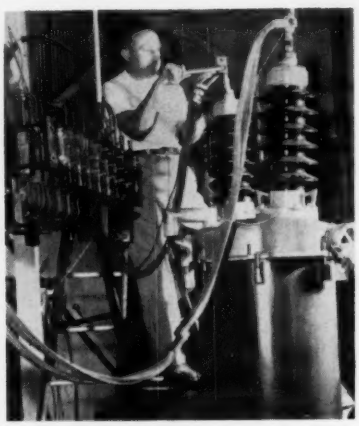
Dr Vsevolod N Krivobok, 65, Supervisor of Stainless Steel and Heat-Resistant Alloy Section of The International Nickel Co, Inc, Development and Research Div, on May 17th.

Dr William Frederick Durand, 99, Dean of American engineers, pioneer in the field of aviation, past-president of the ASME, on August 9th.

William Hunt Eisenman, 73, secretary and founder-member of the American Society for Metals, on May 30th.

Equipment news

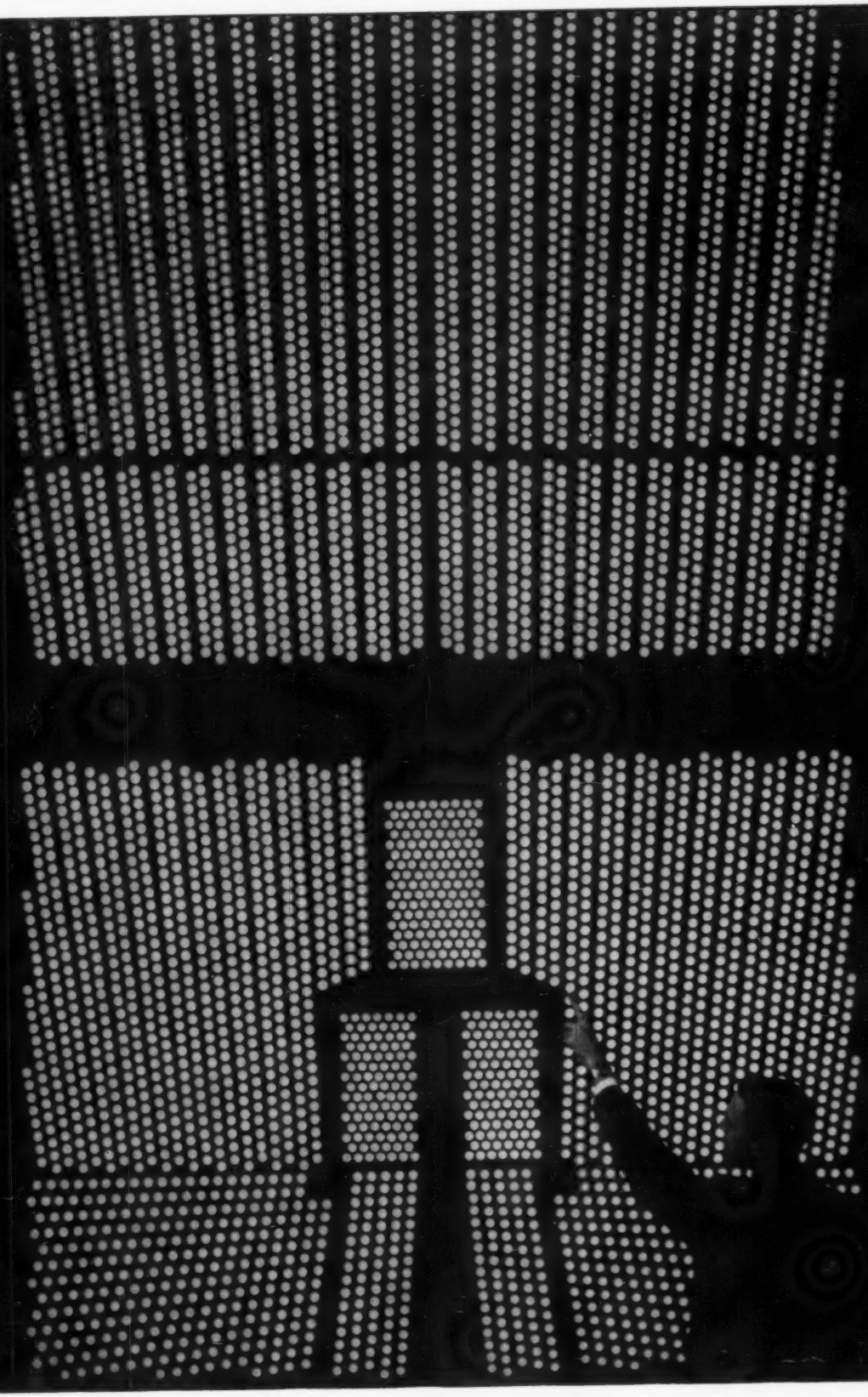
Begins on page 138



Circuit reclosers

908 • Automatic units, 34.5- and 46-kv models, give fast low-cost reclosing protection for subtransmission and higher voltage distribution lines, according to manufacturer. They provide 1½-cycle clearing of 250-mva faults and a 400-amp con-

For more details on these items, use post cards p 151. Identify your request with item number.



This is Marind's tube layout for one bank of a two-pass, divided-flow condenser designed to operate in conjunction with a 156 MW turbo-generator. Generous inter-tube laning; ample belt-steam areaway for reheat, steam distribution and de-aeration in the "hot well"; and a compact, efficient noncondensable gas cooling section . . . are all engineered to meet the needs of a particular turbo-generator. When your plans call for steam surface condensers, take advantage of Marind's many years of engineering experience and facilities for designing and producing condensers of any size.

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MARYLAND SHIPBUILDING & DRYDOCK COMPANY • Industrial Products Division

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one of the 18

MURCO
GATE HOISTS

On the LONG SAULT DAM, ST. LAWRENCE PROJECT, near MASSENA, N. Y.

Each hoist weighs 93,000 lbs., shipped completely attached with all electric motors, controls, limit switches, wired ready for operation . . . the overall length of one unit is 57 feet, 8½ feet wide, 12½ feet high . . . with a lifting capacity of 175 tons . . . will raise and lower the gates in the dam at a speed of 1 foot per minute.

Write for complete information on MURCO Gate Hoists and engineering recommendations to meet your specific power dam requirements.

This is one type of Gate Hoist designed and manufactured by us, backed by 75 years experience. MURCO Gate Hoists are designed in a wide range of capacities from this large Gate Hoist to less than one ton.

D. J. MURRAY MANUFACTURING CO.

WAUSAU OUR 75TH YEAR 1883 TO 1958 WISCONSIN

Equipment news

Begins on page 138

tinuous current carrying capacity.

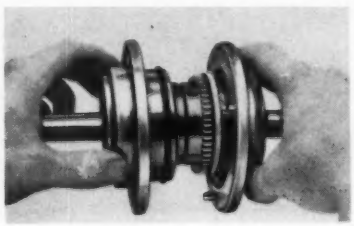
Test results are said to indicate that units give instantaneous tripping in two cycles. The tests, p 196, covered over 130 individual circuit interruptions and a range of current and voltage from minimum to over 3000 amp, rms symmetrical for 46-kv and 4000 amp, rms symmetrical for 34.5 kv, maker states.—*R&IE Equipment Div of I-T-E Circuit Breaker Co, Greensburg, Pa.*

Self-priming pump

909 • Portable unit can handle up to 7000 gph. The large-passage open impeller is said to provide clogless operation. Little maintenance is required, even when the unit is tackling muddy or sandy water, according to manufacturer.

The pump weighs 54 lb; it is powered by a 2¾-hp 4-cycle engine with builtin exhaust valve rotator.—*Hale Fire Pump Co, Conshohocken, Pa.*

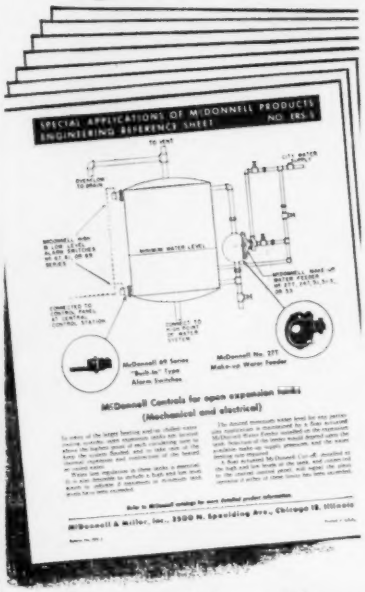
For more details on these items, use post cards p 151. Identify your request with item number.



Geared flexible coupling

910 • Unit is made for shaft diameters up to 1⅞ in. It is designed especially for use as a motor coupling, transmitting electric motor

NEW DATA SHEETS


SPECIAL APPLICATIONS OF McDONNELL PRODUCTS
ENGINEERING REFERENCE SHEET
NO. ERS-5
McDonnell Controls for open expansion tanks
(Mechanical and electrical)
McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, Illinois

—cover special problems solved by McDONNELL products

These recently published engineering reference sheets explain the interesting ways in which engineers are today using McDonnell products to step up efficiency and provide safety in connection with equipment such as:

- Expansion and compression tanks
- Stand-by pumps
- Cooling towers and chilled water systems
- Higher temperature hot water heaters
- Storage tanks and pressure vessels

The simple diagrams and explanations are likely to suggest solutions to many of your operating problems.

Just say, **"send the ERS sheets."**

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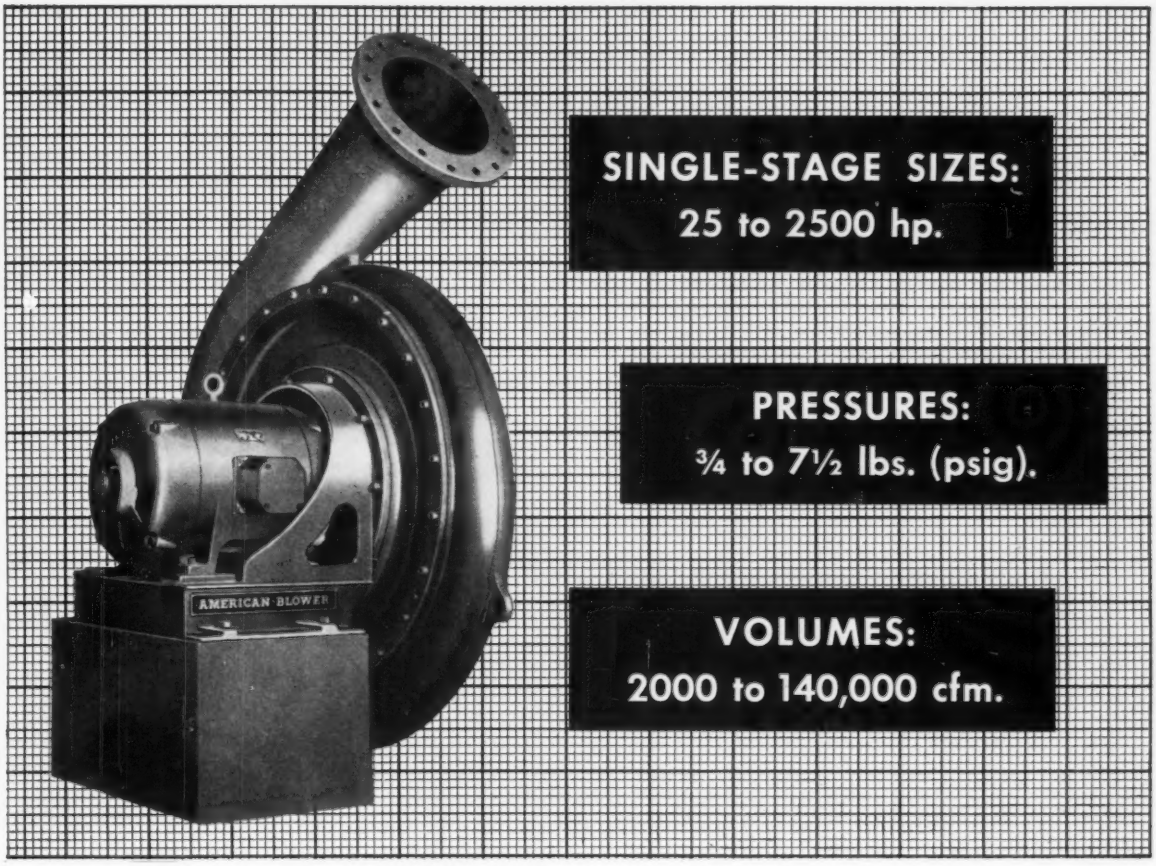
Doing One Thing Well

McDONNELL

Boiler Water Feeders • Low Water Fuel Cut-Offs • Pump Controllers • Flow Switches, Relief Valves • Related Liquid Controls for Tanks, Stills, Air Conditioning Systems

American Blower Centrifugal Compressors



Rate centrifugal compressors for dependable performance, ability to meet specific pressure-volume requirements, minimum space and maintenance requirements. You'll find that American Blower single-stage units score high on all counts.

Adaptable to all drives, American Blower Centrifugal Compressors feature volute casings for increased efficiency. Compressor discharge can be located in increments of 15° in either direction of rotation, permitting great flexibility in application.

Compactness, high-speed operation, statically and dynamically balanced rotating elements minimize foundation requirements. Aerodynamic design of impeller blades contributes to efficiency, assures longer service life.

If you have an application calling for centrifugal compressors, talk to an American Blower sales engineer about your specific requirements. And check with him about American Blower Mechanical Draft Fans, Fly Ash Precipitators, *Gyrol*® Fluid Drives for boiler-feed-pump and fan control. His practical knowledge of air-handling and power-transmission problems may prove most helpful to you.

Call your nearby American Blower branch office, today. Or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard PRODUCTS

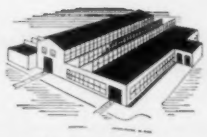
AMERICAN-Standard

AMERICAN BLOWER DIVISION

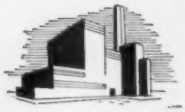
Control enclosures and panels

fabricated by

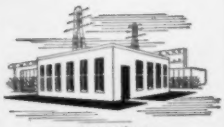
KIRK and BLUM



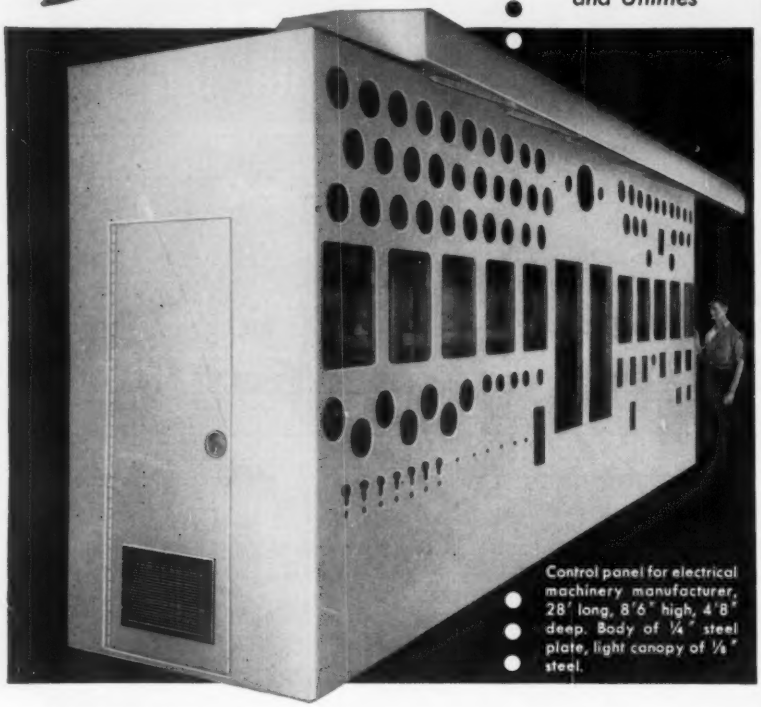
For Industry



Power Plants



and Utilities



Control panel for electrical machinery manufacturer, 28′ long, 8′6″ high, 4′8″ deep. Body of ¼″ steel plate, light canopy of ⅛″ steel.

- CONTROL DESKS and PANELS
- SWITCH GEAR HOUSINGS
- CUBICLES
- TRANSFORMER HOUSINGS and TANKS
- ELECTRICAL ENCLOSURES
- TEST STANDS
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Whether you require panels for 1 or 100 instruments . . . Kirk & Blum is equipped to fabricate them to your most exacting specifications. We offer exceptional experience and facilities for fabricating parts and assemblies of sheet steel, light plate, stainless, aluminum, monel and other alloys in gauges to ½″.

Write for your copy of the latest KIRK & BLUM Electrical Enclosures Booklet. For prompt quotation, send your prints to The KIRK & BLUM Mfg. Co., 3233 Forrer St., Cincinnati 9, O.

KIRK & BLUM

METAL FABRICATION

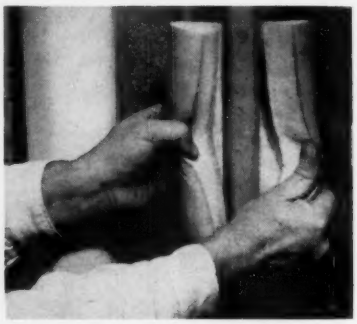
Equipment news

Begins on page 138

power to pumps, generators, speed reducers.

Coupling sleeve is of 1-piece design, and coupling is enclosed in a 2-piece metal cover, sealed to prevent loss of lube or entry of contaminants. Spiral cam-locking fasteners which join cover flanges are permanently assembled as part of cover halves.—*Link-Belt Co, Prudential Plaza, Chicago 1, Ill.*

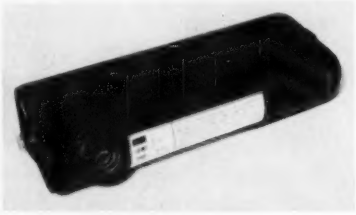
For more details on these items, use post cards p 151. Identify your request with item number.



Crushproof snapon insulation

911 • Snapon thermal insulation has a low k factor and good resistance to physical damage, chemicals and solvents, according to manufacturer. Insulation is designed for service between −200 and +250 F.

Urethane insulation does not fray, crumble or break in handling, or disintegrate when subjected to water or many other liquids. On drying, it's said to be as good as new. Made with only one seam, it comes preformed for pipelines and fittings.—*Allied Chemical Corp, National Aniline Div, 47 West St, New York 6, N. Y.*



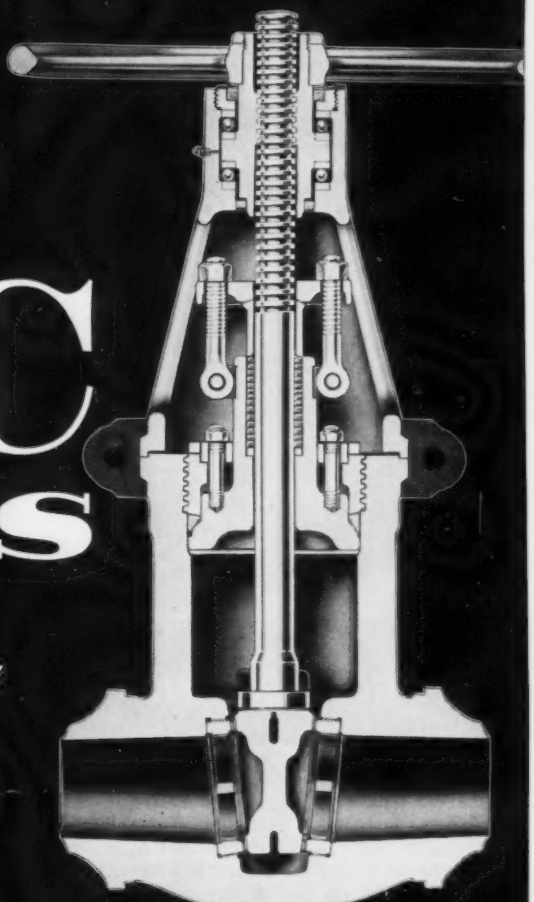
Dehydrator

912 • Unit uses a nondusting bead-type desiccant to remove water-vapor from the air. Air is passed through a 40-micron filter and along an extended flow path for maximum exposure before leaving the dehydrator

ACCO for Better Values

R-P&C VALVES

THE COMPLETE LINE
—DESIGNED FOR DEPENDABILITY



R-P&C Pressure Sealed Valves Meet Requirements of High Pressure and High Temperature Applications

• The R-P&C Pressure Sealed Valve pictured above—made of electric furnace cast steel—has been successfully developed to meet demands for valves that provide tightness under varying conditions encountered at high pressures and high temperatures. These valves, available in gates (up to 12″) and globes (up to 8″) in 900, 1500 and 2500 pound classes, are also being used increasingly for less difficult services, because of the *inherent advantages of pressure-sealed construction.*

Among these advantages are: elimination of bonnet flanges; tightness unaffected by temperture changes; quick, easy inspection—disassembly and reassembly; reduced weight without loss of strength; savings of space; ease of insulation; neat appearance.

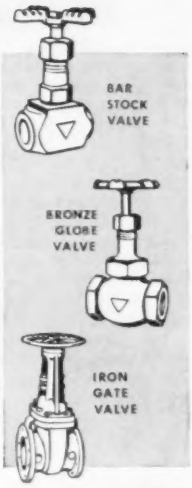
R-P&C Pressure Sealed Valves typify the high quality of the entire cast steel line, including gate, angle, globe, swing check and lift check styles in many sizes and pressure classes (150-2500 psi).

A COMPLETE Line of Valves

Whenever you need valves of *any* kind, it's good business to look to R-P&C. The R-P&C Valve line includes gate, globe, angle and check valves in bronze, electric iron and cast steel, and forged steel. Also, R-P&C offers a full line of cast steel fittings, as well as specialties such as bar stock and Lubrotite gate valves, asbestos-packed cocks and other items.

• • •

Write our Reading office for catalog.



FREE WALL CHART
"How to Protect Your Valves"
Installation pointers, operating tips, clues to longer valve life. They are all on this 22″ x 17″ wall chart. Write for your free copy.

R-P & C VALVE DIVISION
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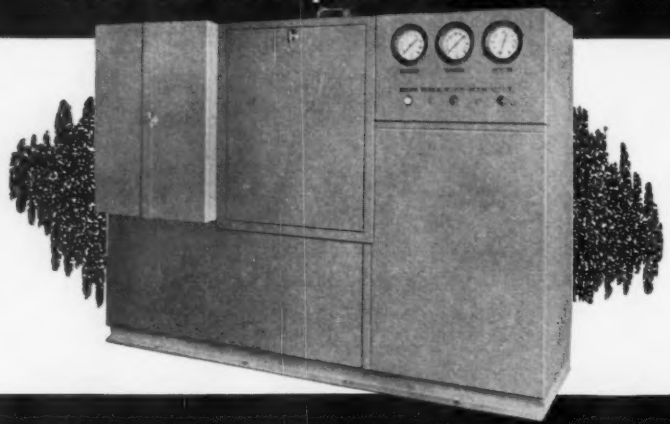
Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

ACCO

NOW - Steam Atomizing
with NATIONAL AIROIL Packaged Firing Units
FOR OIL AND/OR GAS FUELS



AUTOMATIC... ECONOMICAL... CLEAN... SAFE

● Fully Automatic ● Low Fire Start ● Electric-gas Ignition ● Modulating Fire Control ● Damper Sequence Control ● Forced Draft Combustion Air ● Electronic Combustion Safety Supervision ● Mechanical Atomizing — Steam assisted internal mixing oil burner ● Ring or Cylindrical type Gas Burner for gas fuel ● Fire tested before shipment.

NOW . . . with the new Series 20 Packaged Firing Unit you can have all the advantages of the outstanding Dual Stage burner in a completely packaged unit equipped with the latest in electronic safety controls to give *automatic* start, *automatic* modulation, *automatic* shutdown.

Series 20 Packaged Firing Units are factory fire tested, ready for immediate and low cost installation in your furnace room. They need only oil, gas, steam, draft and electrical connections—everything else needed for fully automatic burner operation is there.

Capacities of standard units range from 200 to 830 boiler horsepower. (7,200 to 30,000 pounds of steam per hour). Larger units are available on order to meet your special needs.

Units may be used with any standard boiler or furnace under natural or induced draft, or with pressurized boilers–in which case the unit provides sufficient forced draft to overcome draft loss through boiler. Where a high chimney or induced draft fan is used, an automatic damper motor is furnished to provide a constant furnace draft during operations; and a reduced or zero draft during shutdowns.

Preventative Maintenance consists chiefly of keeping the burner gun clean, with periodic inspection and cleaning of strainers and safety devices. This minimum maintenance will give your engineer or fireman extra time to attend to blow-down, soot-blowing, or to check operations and efficiency of plant and auxiliary equipment.

For complete details, specifications, illustrations, and dimensions write today for Bulletin No. 28.

When used in conjunction with a National Airoil Fuel Oil Pumping and Heating Unit (Bulletin No. 40) a most reliable combination results.

National Airoil
BURNER COMPANY, INC.

Main Office & Factory: 1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

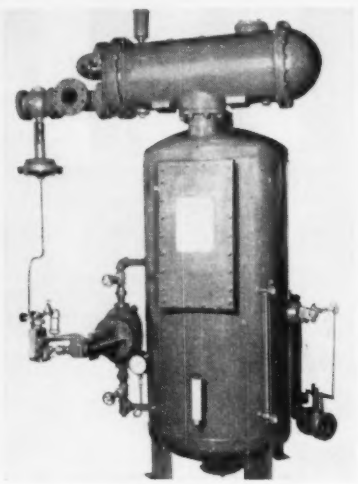
SOUTHWESTERN DIVISION 2512 SOUTH BOULEVARD, HOUSTON 6, TEXAS

Equipment news

Begins on page 138

through a 10-micron filter. An indicator tube shows when relative humidity for the air leaving the dehydrator exceeds 4%, indicating that the unit needs reactivation.

The solid desiccant is chemically inert. Unit works at 35 psig.—*Farr Co, Farr Bldg, Los Angeles 45, Calif.*



Liquid-level control

913 • Pilot-operated control is said to maintain any desired level within one to two in. ± the setting. Unit consists of exterior float, pneumatic pilot, and diaphragm motor valve. Float movement causes pilot to apply or release pressure on the valve; open or close the feedwater inlet.—*Stickles Steam Specialties Co, 2215 Valley Ave, Indianapolis 18, Ind.*

For more details on these items, use post cards p 151. Identify your request with item number.

Rubber-element check valve

914 • A synthetic-rubber element is permanently molded to a threaded nipple at valve's intake end. Element's other end is in a deflated position when flow stops, and opens to the full area of the pipe when flow is established.

Valve element is soft and resilient, able to reduce line shock and absorb foreign matter. Element may be

Here's Why . . .

You Save With Silicone Insulated Outdoor Motors for Power Stations

Silicone insulation is establishing a trend toward less costly enclosures for auxiliary drive motors in power stations. By readily withstanding moisture and contaminants circulated in ambient air, Dow Corning silicone insulation makes possible more open enclosures and lower cost per horsepower.

Leading electrical equipment manufacturers already offer complete lines of silicone insulated "all-weather" motors in ratings from 100 to 5000 horsepower.

Safe, reliable operation outdoors the year 'round is assured by Dow Corning silicone insulation. Experience has shown silicone insulated motors readily withstand torrential rains, hurricane winds, corrosive fumes, fly ash, dust, salt air, snow, sleet, cold, heat — even flooding.

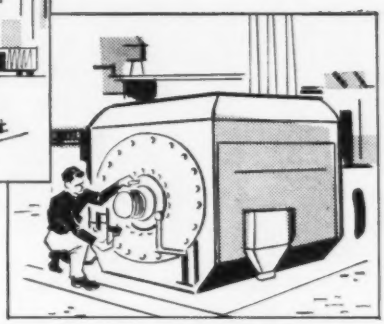
Extra overload capacity is provided by the silicone insulated windings. As a general rule, silicone insulation offers a 50% greater service factor and lasts at least 10 times longer than Class B insulation under similar operating conditions. That's why for the most dependable auxiliary drive motors, it's wise to

Specify DOW CORNING SILICONES and *Save*

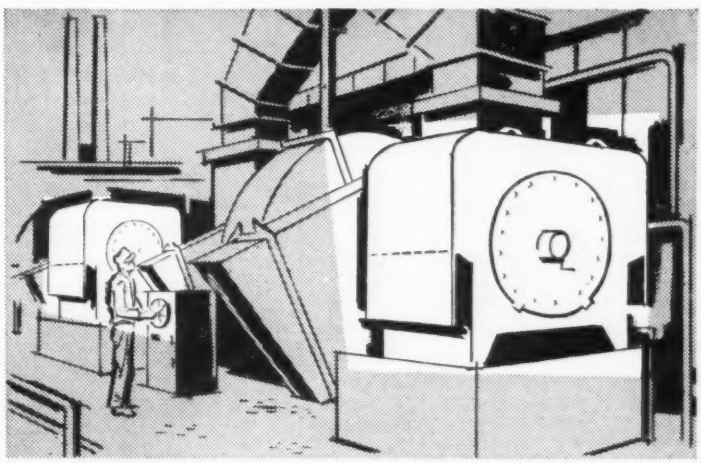
JUST PUBLISHED!

Send for your copy of new 8-page brochure detailing how silicone insulation cuts motor enclosure costs while adding to the reliability of electrical equipment.

Initially, motors were sheltered in buildings . . .



Later, motor enclosures themselves sealed out surrounding atmosphere

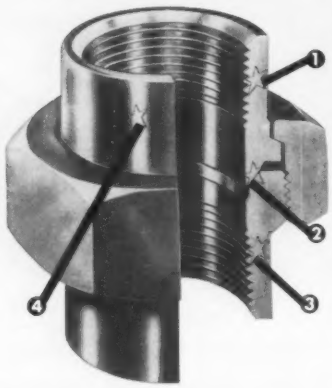


Now, silicones protect motor parts permitting the circulation of ambient air . . . lower-cost enclosures.

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

only
CATAWISSA
gives you all these features for your forged steel pipe union requirements



1. **Uniform walls** for even expansion and contraction under temperature changes. They follow the pipe!

2. **Catawissa Ball-to-Angle Seats** give you a "Perfect Seal" regardless of pipe alignment!

3. **More than adequate** wall thicknesses give you Catawissa's 3-to-1 Safety Factor (3000-lb. service, 9000-lb. test; 6000-lb. service, 18000-lb. test)!

4. **Round, straight barrels** for fast wrenching. No uneven or tapered surfaces to cause wrench slips or wrench locking!

Catawissa Perfect Seal Pipe Unions are made by Union Specialists from 80,000 lb. tensile strength steel (ASTM Spec. A-105-55T, Grade II). Steel forgings from our own forging mill are closely checked for imperfections . . . and finishing on modern, automatic machines with close inspection during and after production give you pipe unions second to none!

Write for Catalog 58 showing the complete Catawissa line of Perfect Seal Products.

for complete, guaranteed satisfaction

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CATAWISSA VALVE & FITTINGS CO.
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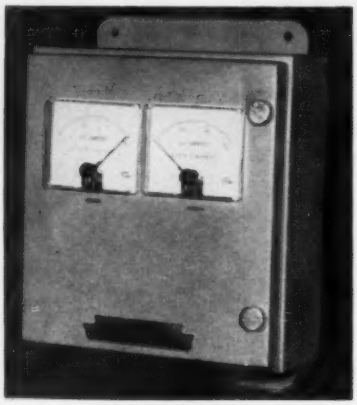
Equipment news

Begins on page 138

added to any standard pipe fitting, and used as a foot valve, a vertical or horizontal check valve or an angle valve, for compressor, refrigeration and lab applications.—*Harman Equipment Co, 3605 E Olympic Blvd, Los Angeles 23, Calif.*

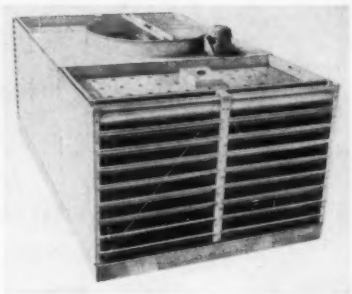


Machine load control

915 • Unit is designed to protect machinery and equipment through automatic shutoff, warning or continuous on-off operation.

The control can protect against overload, underload, no-load and phase failure. It comes with two separate contact ammeters activated by a current transformer connected in one of the motor leads. Indicating pointers move identically across the two dials, continuously monitoring and displaying the load on the drive motor. —*Tipptronic, Inc, Chagrin Falls, Ohio.*

For more details on these items, use post cards p 151. Identify your request with item number.



Cooling tower

916 • Low-silhouette unit has capacities ranging upward from 75 tons. It features all-steel structural members that are hot-dipped galvanized after fabrication for extra

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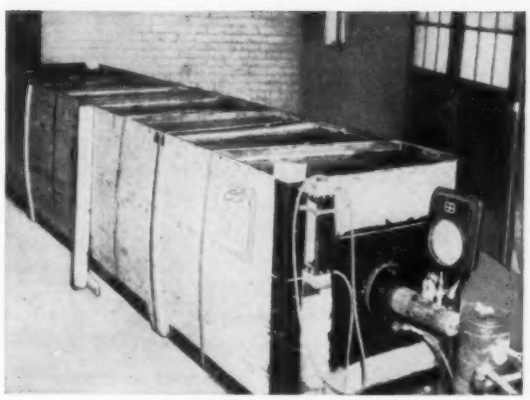

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The Chemical Treatment of Boiler Feed Water. This technical bulletin contains a clear explanation of the causes of boiler water problems and Western's methods of solving them. Special emphasis on scale prevention, corrosion control, sludge dispersion, and suppression of foaming and carry-over.

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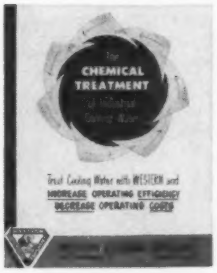
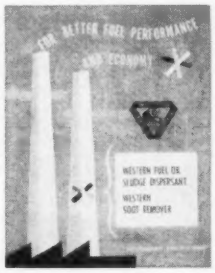


The Chemical Treatment of Industrial Cooling Water discusses common cooling water problems—scale, corrosion, algae, slime. Also presents Western's proven methods for controlling and preventing these conditions in cooling towers, evaporative condensers, process heat exchangers, engine and compressor jackets, chilled water systems, etc.



Better Fuel Performance and Economy discusses the causes and effects of sludge in fuel oil supplies and soot deposits in combustion areas. Shows how these troubles can be eliminated economically, dependably, and permanently with time-tested special Western formulas.

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WESTERN CHEMICAL COMPANY

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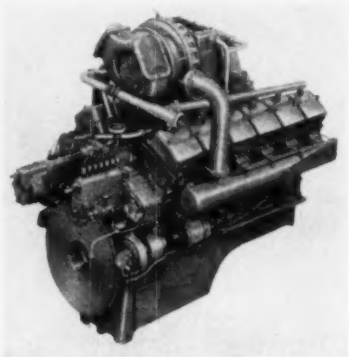
Equipment news

Begins on page 138

corrosion protection, manufacturer states. Louvers, casing, distribution system and fan deck are made of asbestos cement.

The tower is designed to conform to standard fire codes. Deck fill and drift eliminators are redwood.—*J F Pritchard & Co of Calif., 4625 Roanoke Parkway, Kansas City 12, Mo.*

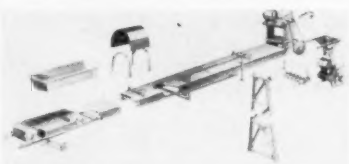


Diesel engine

917 • Available in 625 to 1025 hp from 1000 to 1500 rpm, unit is a 12-cylinder V-type vertical 4-cycle liquid-cooled turbocharged engine with a compression ratio of 16:1. It weighs 6116 lb with overall dimensions of 94½x53x77 in.

Glow plugs are said to give fast starting. Unit can be applied to generator sets and large pumps.—*Made by Mercedes-Benz; U.S. distributor is The Utica Div, Curtiss-Wright Corp, Utica, Mich.*

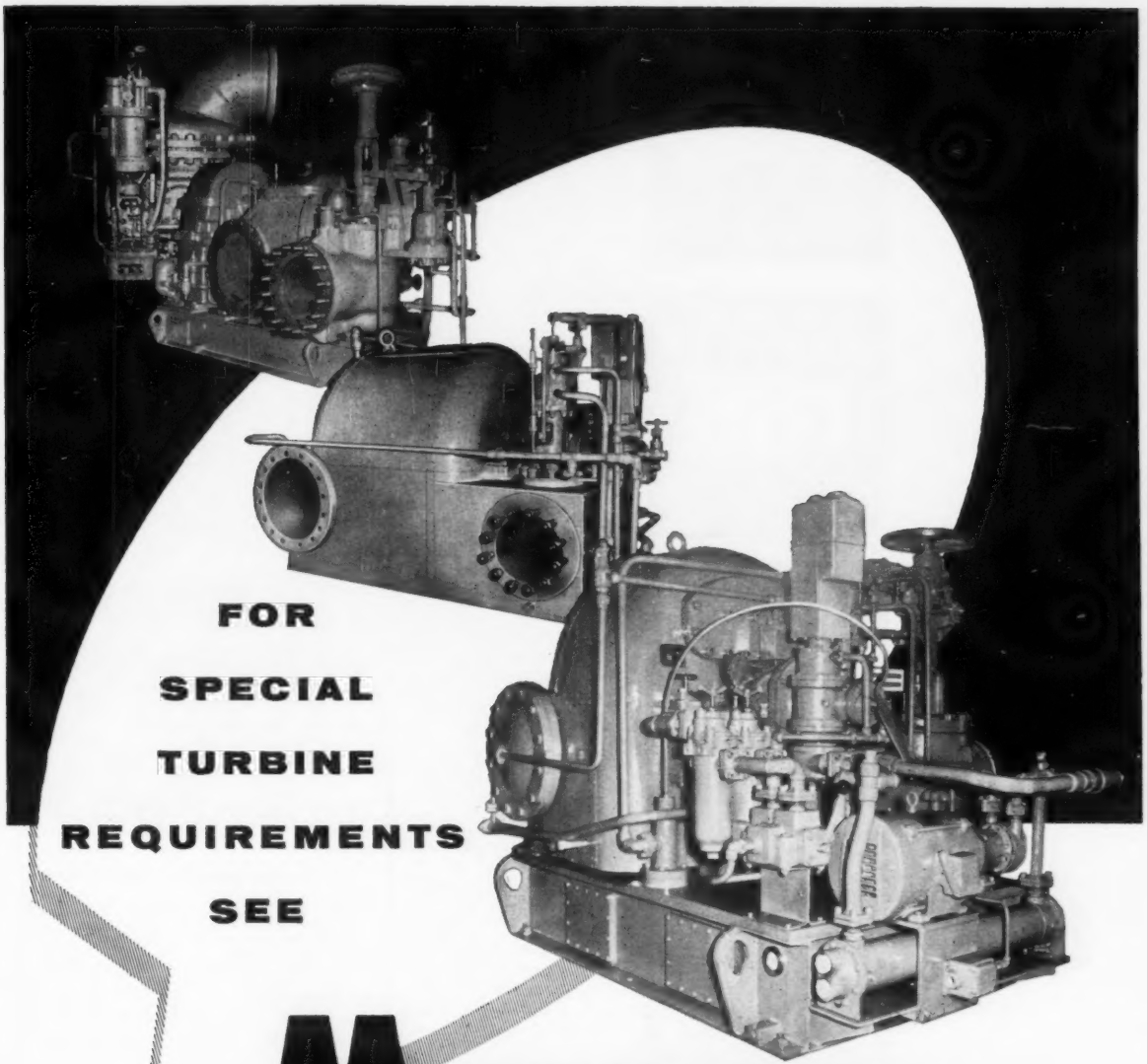
For more details on these items, use post cards p 151. Identify your request with item number.



Sectional belt conveyor

918 • Packaged unit comes complete with head and tail assemblies, supporting "A" frames and intermediate sections of bent-plate decking. The conveyor is made in 18-, 20-, 24-, 30- and 36-in. belt widths, with drives ranging up to 50 hp.

Bent-plate decking has bolt holes punched every eight in. in rows on top, bottom and sides. The 12-ft sec-



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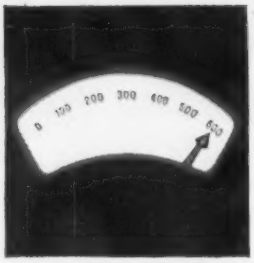

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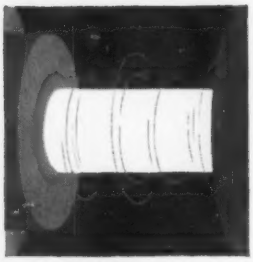
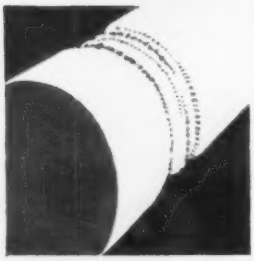


...packings whose lubricants will not go up in smoke when the heat and speed are on...

ADD UP TO TROUBLE UNLESS . . .



...because improper packing materials can cause costly damage to parts, interfering with your production.

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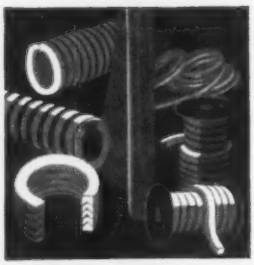

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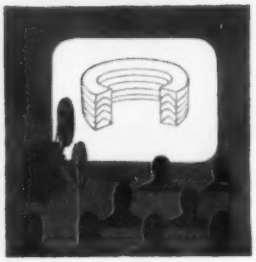

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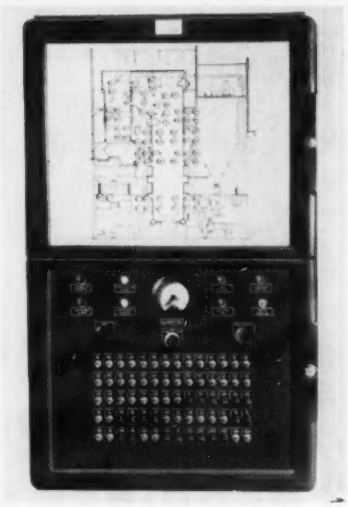
Brake Blocks • Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

Equipment news

Begins on page 138

tions offer flexibility in lengthening, shortening and altering the conveyor, maker states. Decking provides its own protection for the return belt run. — *Stephens-Adamson Mfg Co, Ridgeway Ave, Aurora, Ill.*

For more details on these items, use post cards p 151. Identify your request with item number.

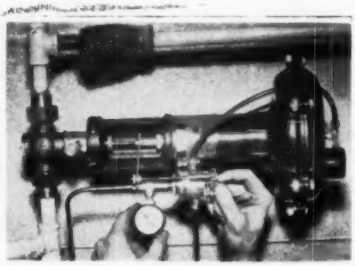


Soot-blowing system

919 • System is said to give boiler operator finger-tip control of every step in the soot-blowing sequence. He can preselect any number of blowers to be operated through automatic sequence or individually, to be sure of best cleaning action.

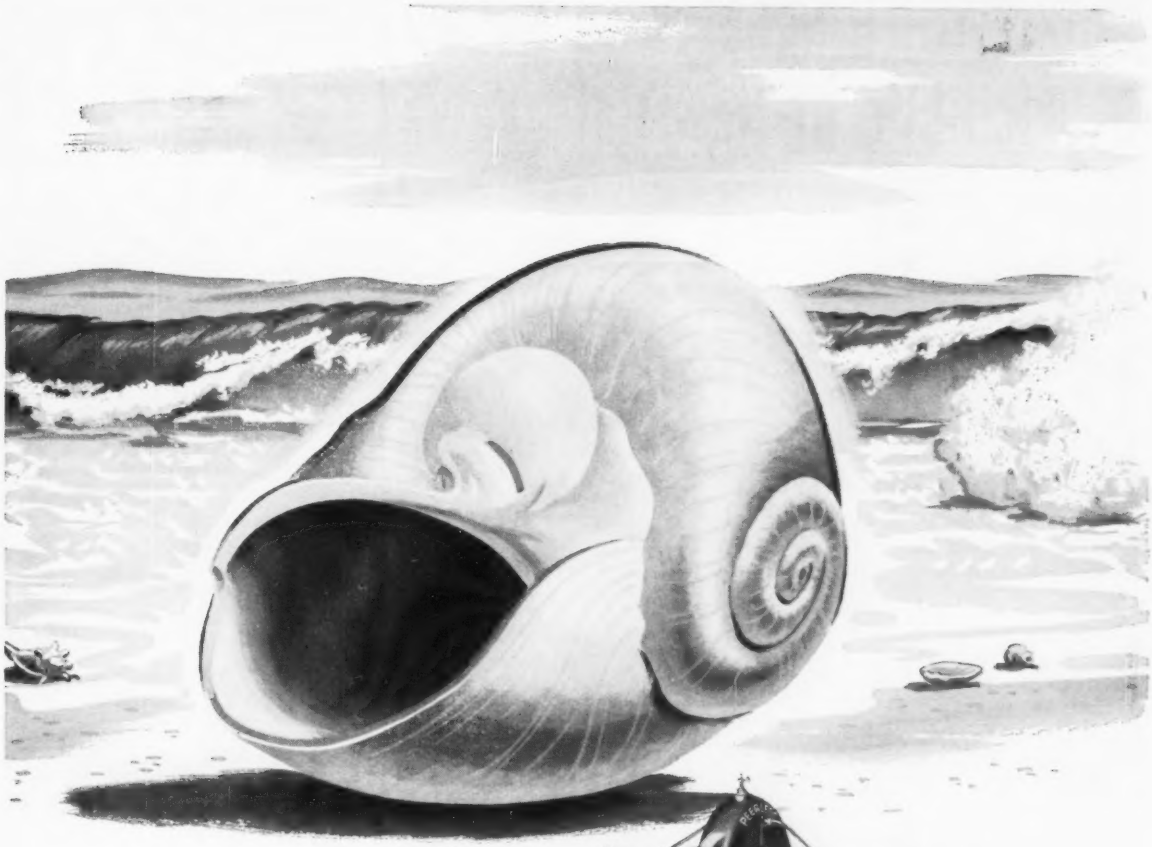
System also permits reversing any retractable blower at any point in its cycle, switching from automatic-sequence to single-unit operation. Instant warning is given in case of trouble, maker states.

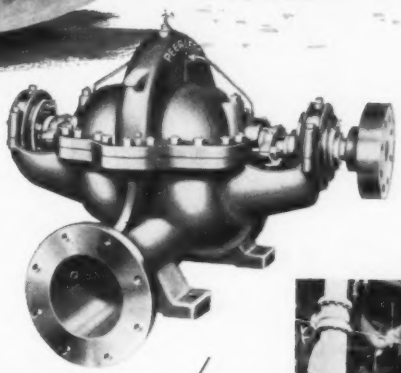
There are three models to control 120, 60 and 45 blowers—*Blaw-Knox Co, Copes-Vulcan Div, Erie, Pa.*

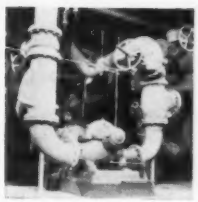


Adjustable pneumatic relay

920 • Adjustable positioning relay provides accurate control of pneu-







"Field tested" for thousands, perhaps millions, of years, the simplicity of design of this sea shell has proved its practicability as dependable housing. In its field, the design of the Peerless Type A horizontal split-case pump is quite as remarkable. The split at the center line allows easy maintenance without disturbing the piping. The rotating element lifts out as a unit for inspection or repair. Mechanically and hydraulically, the quality and operation of this pump is unsurpassed – *it is the type of pump you can apply with absolute confidence to general purpose pumping duties in the broadest sense.* An added advantage: the Type A pump line is the broadest offered by any manufacturer.

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design / application

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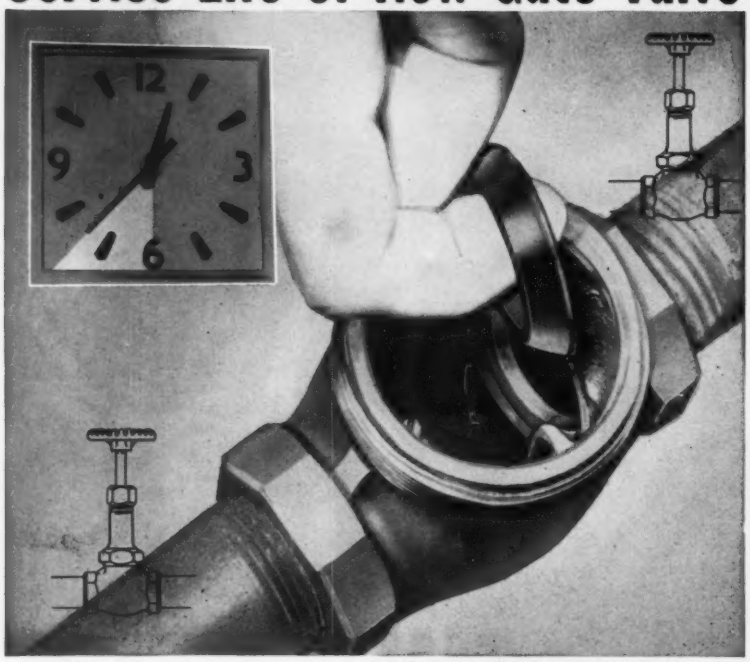
Only 7 to 10 Minutes to Renew Service Life of New Gate Valve



Patented development assures replacement of seat ring while valve remains installed.

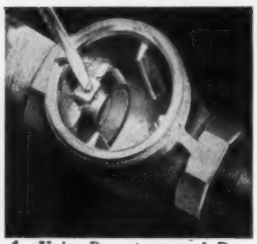
Without removing the valve body from the line, you replace the nickel-alloy seat rings in Fairbanks new patented Renewable Seat Ring Gate Valves. In 7 to 10 minutes, from the time the line is shut down until it is put back into operation, you have given a new service life, a new life of dependable tight closure to your valve.

Just 7 to 10 minutes of your maintenance man's time — only 7 to 10 minutes of "down-time" on your steam, water or process piping lines — and you have the equivalent of a new valve in the line. Think of the savings: where once at least one hour, under the most ideal conditions, was required to replace a gate valve in the line, the job is now accomplished in from 7 to 10 minutes.

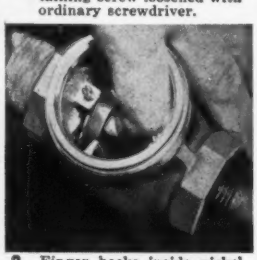
Field tested for over two years, under all conditions from steam to corrosive liquids, the revolutionary new Fairbanks Renewable Seat Ring Bronze Gate Valve has proven completely satisfactory — absolutely dependable.

Made with either rising stem or non-rising stem construction in ½",¾",1", 1¼",1½" and 2" sizes, the Fairbanks Renewable Seat Ring Bronze Gate Valves are recommended for severe service conditions on 200 lb. steam pressure at 550 degrees F., 400 lb. water, oil or gas pressure — non-shock — lines requiring full flow and subject to frequent operation. Nickel alloy seat rings and wedge make the valves particularly tough and corrosion resistant.

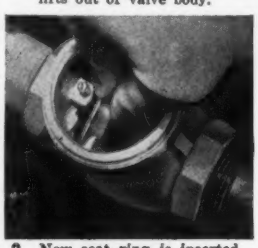
YOURS ON REQUEST: Illustrated, descriptive folder gives complete information on Fairbanks Renewable Seat Ring Gate Valve with details and specifications. Yours without charge. Write today.



1. Union Bonnet removed. Retaining screw loosened with ordinary screwdriver.



2. Finger hooks inside nickel alloy seat ring. Seat ring lifts out of valve body.



3. New seat ring is inserted. Retaining screw tightened. Bonnet replaced.

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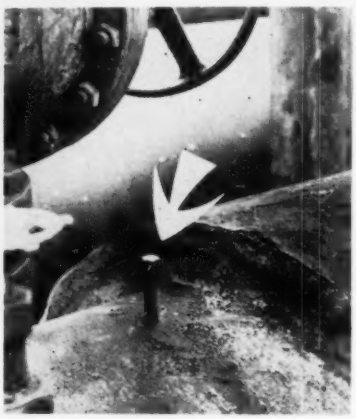
matic motors and valves, can be installed with a screwdriver and wrench, according to maker.

The relay is designed to counteract effects of friction and load factors. Unit attaches directly to motor or valve. It is said to assure specified performance of new equipment, and it can also be used to tune up sluggish existing motors and valves, or adapt them to increased load conditions.

Fits 3-, 4- and 6-in. pneumatic motors, and 8- and 12-in. diaphragm valves. The relay can handle multiple installations of four 6-in. or ten 4-in. motors.—*The Powers Regulator Co, 3434 Oakton St, Skokie, Ill.*



Inspection-hole test plugs

921 • Units plug small inspection holes used by metal inspectors for measuring thickness of walls of pressure vessels, process equipment and piping. They come in carbon steel, Monel, brass, stainless steel (316) and Inconel, to assure compatibility with the metal of the tapped hole and to prevent galvanic action between wall and test plug.—*Nuclear Products Co, 15635 Saranac Rd, Cleveland 10, Ohio.*

For more details on these items, use post cards p 151. Identify your request with item number.

Extreme-pressure lube

922 • Designated *Molylube 110-L*, this product comes packaged in a self-contained polyethylene oil can that is shatterproof and reusable.

The solvent refined petroleum oil contains a stable dispersion of molybdenum disulfide. It is said to impart a tough film capable of withstanding shock loads and wiping action. Ad-

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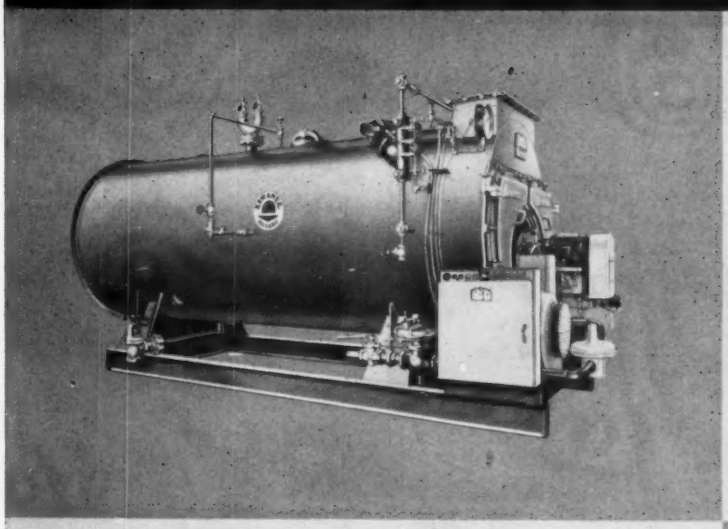
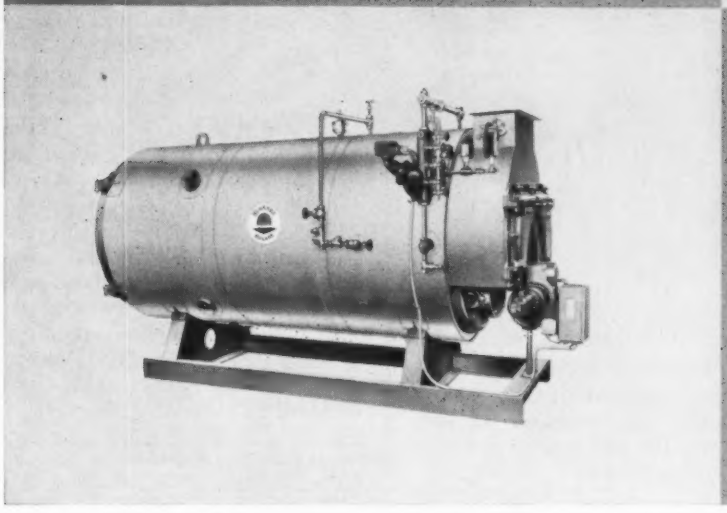
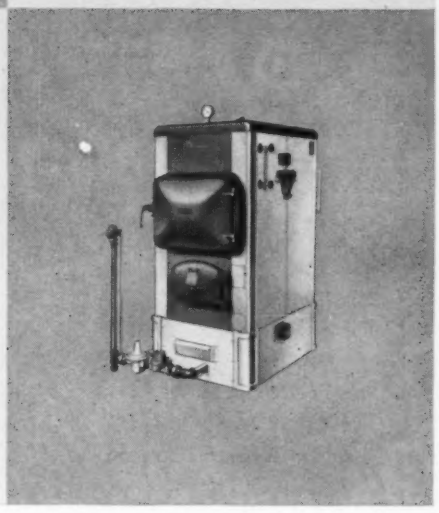


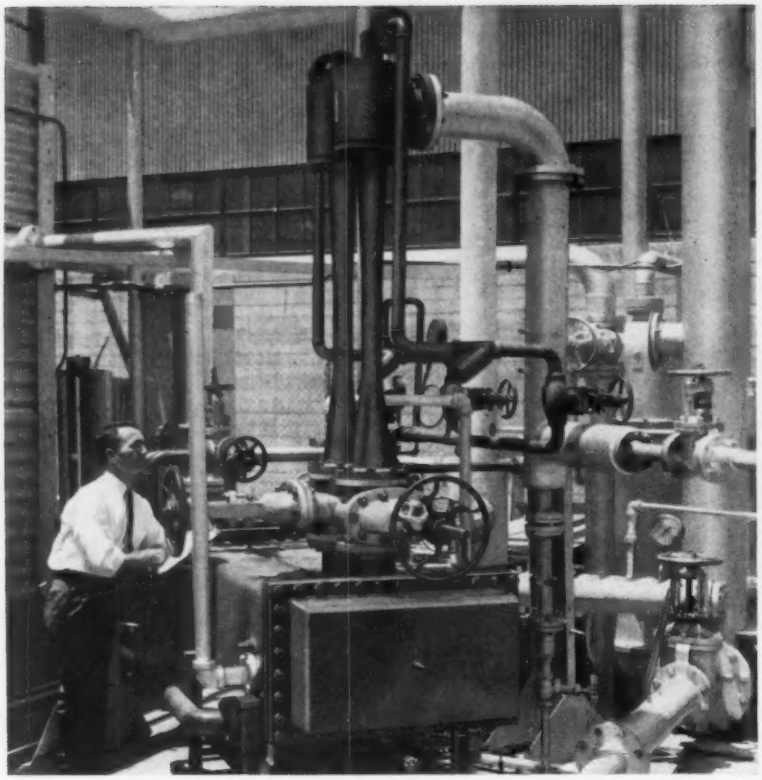




Now Kewanee's family of integrated boiler-burner packages covers a spread of sizes from 18 to 651 hp in high pressure models . . . 216,000 to 21,855,000 Btuh, low pressure. The fuel range is all-inclusive, too—oil from No. 1 through No. 6 . . . natural, manufactured, mixed or LP gas . . . oil-gas combination firing on any Scotch type package . . . forced draft eliminates high stacks. Factory assembling and fire-testing on Scotch type packages, when desired, means only five simple connections for installation. For complete facts on any type, any size or any fuel, contact your nearby Kewanee Man. AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 111 Franklin Street, Kewanee, Illinois.

AMERICAN-Standard

KEWANEE BOILER DIVISION



A rigid "shakedown test" of performance is given each SWECO steam jet ejector before delivery to a customer.

Steam Jet Ejectors —To Order

When your process calls for vacuum equipment, you should consider SWECO steam jet ejectors —for three good reasons:

First, Economy

Steam jet ejectors offer important capital and operating economies in producing vacuum for your process. SWECO's application engineers thoroughly study your vacuum requirements and utilities, to arrive at the optimum balance between initial cost, installation cost, and operating cost.

Second, Design

SWECO's staff of ejector and condenser specialists pool their talents and experience to engineer the best unit for your particular vacuum application . . . the right materials . . . the right number of stages . . . the right types and sizes of condensers . . . the right dimensions. Where practical, standard designs and components are used.

Third, Dependability

SWECO tests every ejector to measure its performance before the unit is shipped.

SWECO's steam jet ejectors are now in use in the petroleum, chemical, power, and food industries. A complete line of ejectors and condensers is available to meet your requirements.

Write today and let us know of your vacuum equipment needs. Our catalog, with a valuable set of Dalton's Law Charts is also available on request. Ask for Data File M-10-393.

SWECO

Southwestern Engineering Company

4800 Santa Fe Ave., Los Angeles 58, Calif.
Engineers & Constructors . . . Manufacturers

Equipment news

Begins on page 138

ditives are said to help prevent rust.

High viscosity index makes it good for lubrication of bearing and machine parts at high temperatures, according to manufacturer. — *Bel-Ray Co, Inc, Green Village Rd, Madison, N. J.*

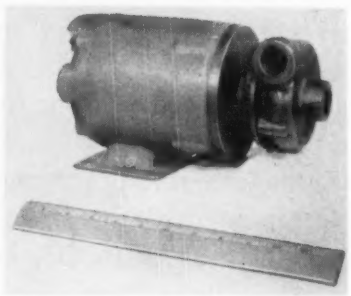
Air placement of concrete

923 • Concrete-placer unit in a typical application, above, used a 105-cfm air compressor to place a 1-2-3½ concrete mix with 1-in. rock through the 4-in. ID steel concrete-placement tubing. This job needed a 25-ft vertical lift and a total pipe length of 150 ft.

Concrete-placer units come in two models, one to handle 10 cu ft of concrete per charge and one handling 15 cu ft per charge. Either 4- or 6-in. ID tubing is available for use on both models. Tubing size depends on rock size, production rate and available air.

Units feature complete portability, maneuverability, flexibility in setup. —*Air Placement Equipment Co, 1009 W 24th St, Kansas City, Mo.*

For more details on these items, use post cards p 151. Identify your request with item number.



Centrifugal pump for labs

924 • Small chemical pump-motor unit has capacities up to 16 gpm and heads to 28 ft. It is designed for

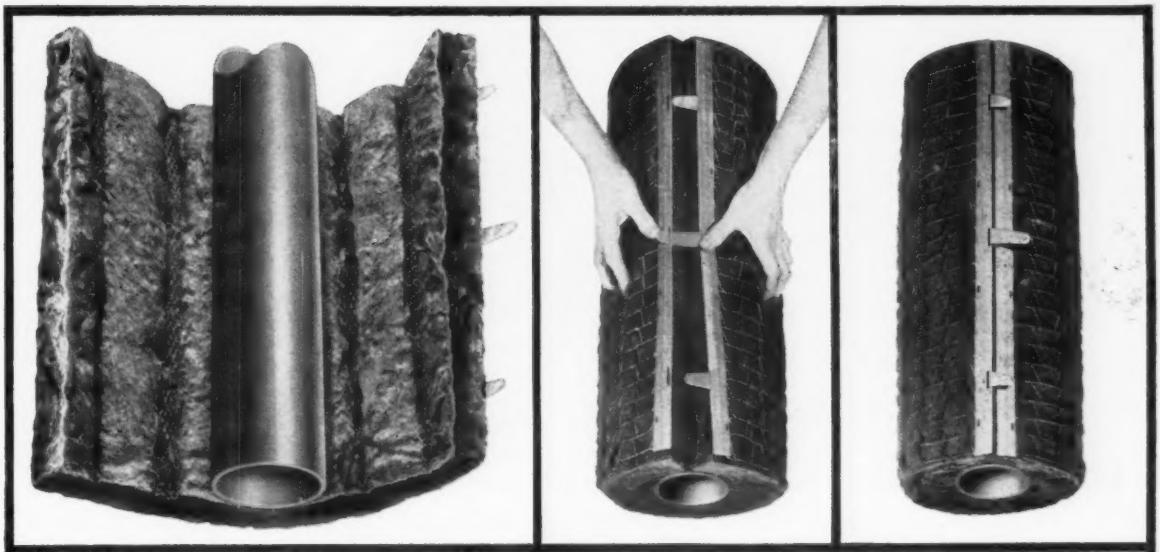
NOW! HIGH TEMPERATURE INSULATION - EASY TO APPLY

EAGLE-PICHER

TAB-LOK

PIPE INSULATION

For temperatures up to 1200F



And it's made of Eagle-Picher Mineral Wool!

SAVES TIME AND LABOR! On long overhead steam transmission and steam tracer lines, apply *Tab-Lok* in about half the time required by ordinary pipe coverings. Easy to handle . . . cut and fit . . . simply draw tabs through slots, pull taut and bend tabs over. No reinforcing needed!

PRECISION-MADE TAB-LOK is Eagle-Picher's new, highly efficient mineral wool pipe insulation, especially designed for fast, easy application on steam piping and hot lines up to 1200 F.

TIGHT, UNIFORM INSULATION! Durable metal fabric and galvanized strips keep *Tab-Lok* in uniform alignment. The unique tab-and-slot feature assures tight, close-butted joints.

WHAT'S MORE . . . Eagle-Picher's new *Tab-Lok* pipe insulation is highly resilient for minimum stress in expansion and contraction of heated equipment. It's water-repellent, corrosion-resistant, fire-resistant, vibration-resistant! Its greater efficiency plus ease and speed of application, saves you money!

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

Since 1843

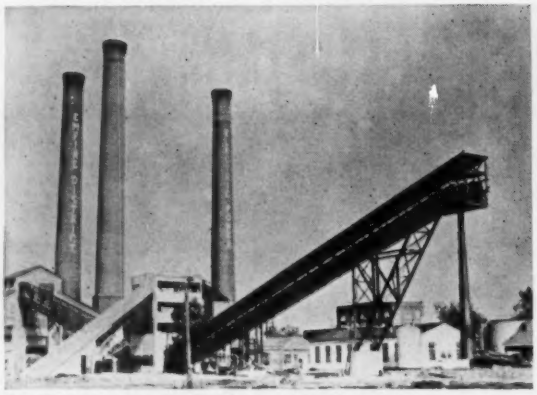
EAGLE EP PICHER

EAGLE-PICHER

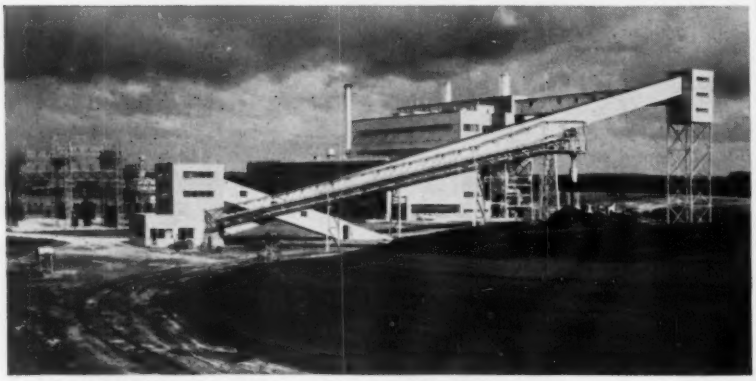
The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)

EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG

"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ **Title**_____

Company_____

City and State_____

Equipment news

Begins on page 138

heavy-duty continuous operation with any equipment requiring corrosive liquid circulation, especially in pilot plants and laboratories.

Unit is made of 316 stainless steel. It is a standard volute-type centrifugal design, maker states. Suction and discharge connections take standard ¾-in. piping. External adjustment of impeller clearances is said to compensate for wear.—*Goulds Pumps, Inc, 43 Black Brook Rd, Senaca Falls, N. Y.*

For more details on these items, use post cards p 151. Identify your request with item number.

Climatized motor

925 • All-weather vertical hollow-shaft motor comes in ratings up to 2000 hp. Unit is designed for indoor and unprotected outdoor service. A maximum of 2-high angular bearings is used to prevent excessive wear and reduced thrust capacity. Design allows bearing inspection of the largest motors in five minutes, according to the manufacturer.—*Louis Allis Co, Milwaukee 1, Wis.*

Dry type power center

926 • Economy of space is feature of this unit, maker states. Small size comes from new arrangement of components and use of core and coils from the compact transformer.

The power centers come in 5- and 2.5-kv classes for high voltage, 600, 480, 240 and 120 v for low; 3-phase ratings are from 45 to 300 kva.

Unit uses an air-insulated 3-phase load-break switch with or without fuses. Top or bottom entrance is possible.—*Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.*

You know you're safe with USS National Seamless Tubes

In a giant superheater like this, or in any tubular installation where pressures and temperatures are intense, where strength is critical, power engineers specify "National Seamless Steel Tubes." Reason: National Seamless gives longer, safer, more dependable, more economical service. And what more could any tubular product offer?

For further details, send for Bulletins 12 and 26. For technical assistance, don't hesitate to get in touch with us. Our mill service force is available for field consultation. Write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks.

"The world's largest and most experienced manufacturer of tubular products—National Tube"

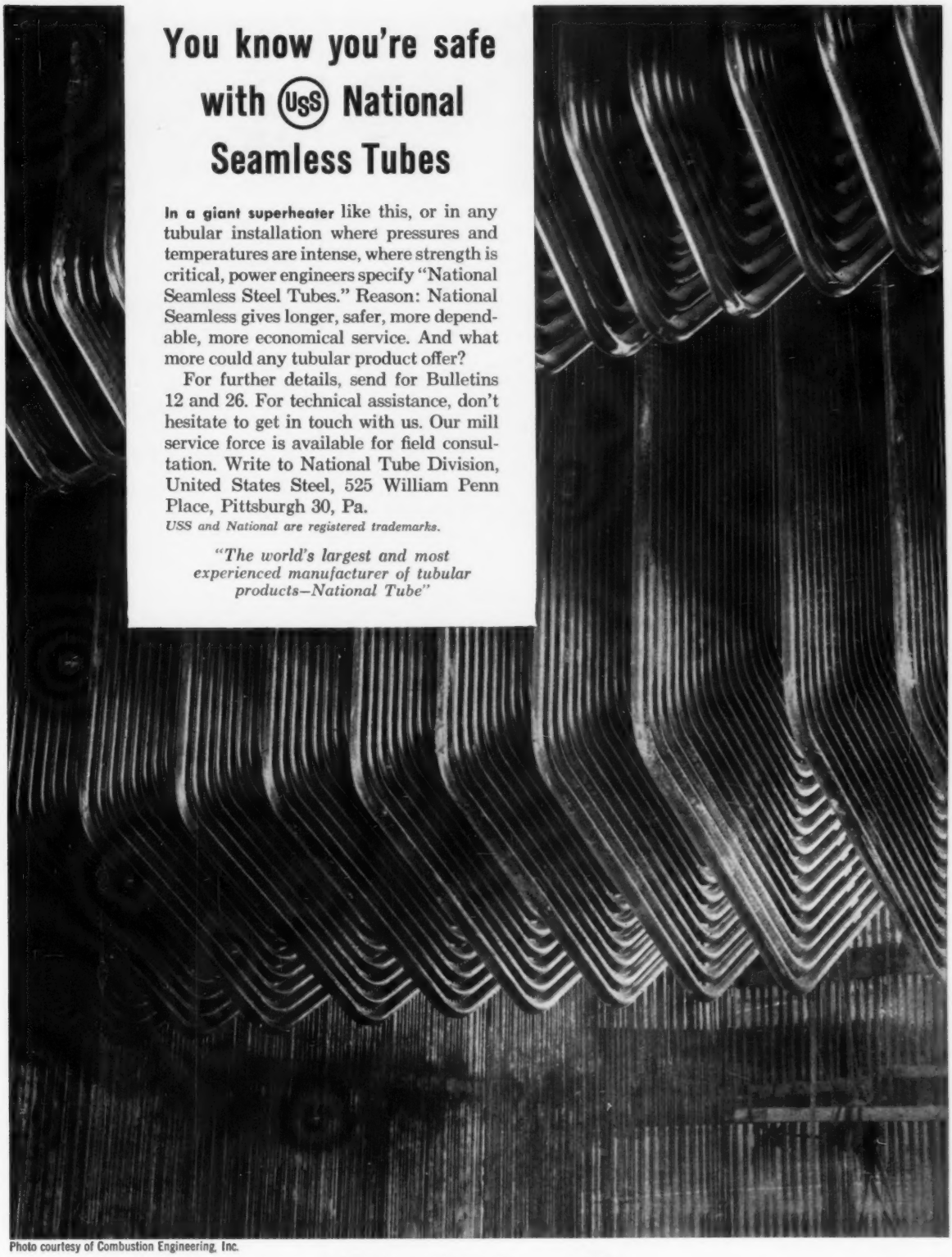
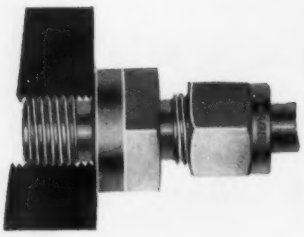


Photo courtesy of Combustion Engineering, Inc.

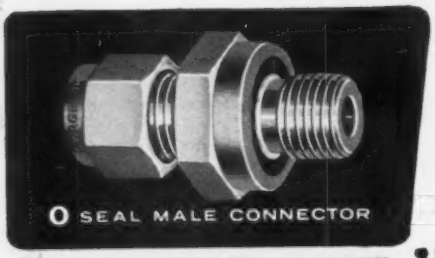
National Tube Division of USS United States Steel

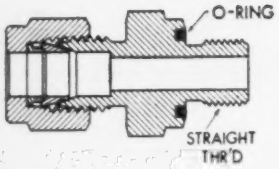
Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Supply Division • United States Steel Export Company, New York

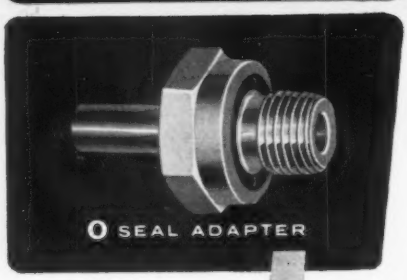
Eliminate even minute leakage

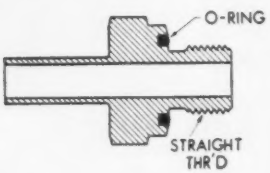


in critical applications with









Swagelok® O seal fittings

Swagelok O Seal Fittings, with straight machine threads, eliminate every possibility of leakage that usually accompanies the use of ordinary taper pipe threads.

Swagelok O Seal Fittings are completely assembled, ready for immediate use. The O ring seal is held in the body of the fitting and a variety of O ring materials for specific applications is available.

Installation of Swagelok O Seal Fittings is simple. Just drill and tap — no counterboring or port contour cutting necessary. The use of messy pipe dopes or sealants of any kind is completely eliminated.

Screw in Swagelok O Seal Fitting, tighten and the installation is complete. A pressure or vacuum seal can be obtained against any flat surface.

A wide variety of connections is possible thru the use of Swagelok O Seal Adapter.

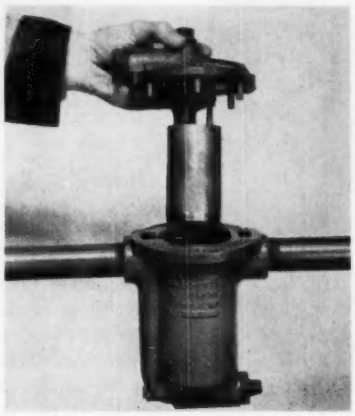
Swagelok O Seal Fittings are available in all machinable metals and plastics in tube O. D. sizes from 1/16″ thru 1″.

For name of your local Swagelok Distributor, write Dept. E-5

CRAWFORD FITTING COMPANY 884 East 140th Street, Cleveland 10, Ohio

Equipment news

Begins on page 138



Bucket type trap

927 • Designed for 0-150 psig, the *500-C* series, open-float and thermostatic type, provides for faster warmup and efficient handling of entrainment in every stage from cold start to saturation temperatures.

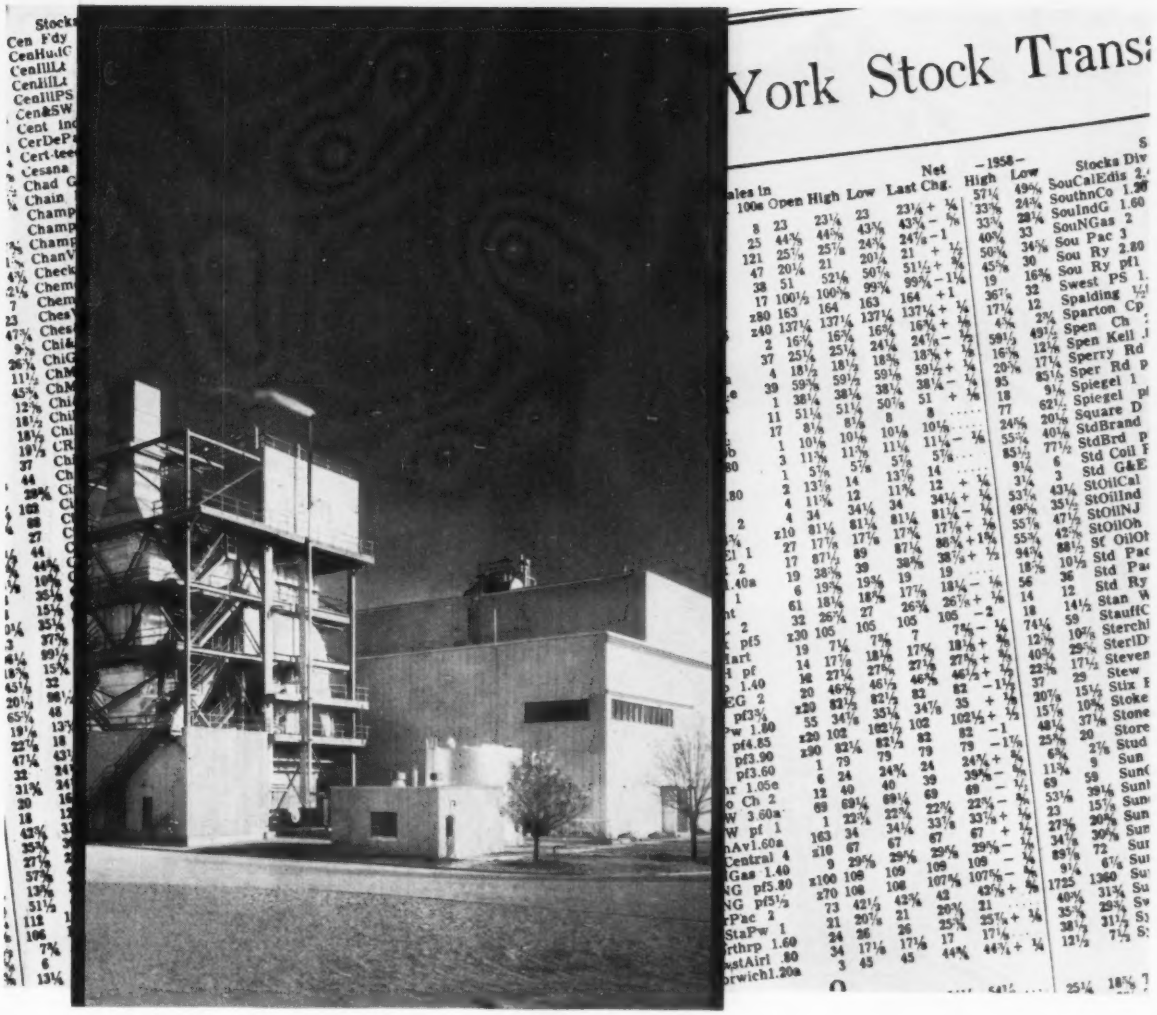
Fast warmup is due to efficient venting and discharge of air and condensate in the preliminary stage, maker states. Units can discharge at 1 and 2 deg below steam saturation temperatures, keeping equipment hotter after the initial warmup cycle. All parts are accessible for service without removing the trap body from the line, see photo, above.

Bypass thermostat is built into the trap. It is a liquid-filled monel bellows-type assembly, pressure and temperature compensated. Thermostat starts to open at 10 deg below saturation temperature and is fully open at 25 deg below. Bypass is above the line inlet so that solid entrainment will not interfere with its operation while open during the warmup stage. — *Wright-Austin Co, 3245 Wight St, Detroit 7, Mich.*

For more details on these items, use post cards p 151. Identify your request with item number.

Acid cleaner

928 • Inhibited muriatic acid is said to effectively remove most water scales and corrosion products from boilers, recirculated cooling-water systems and water heaters. The cleaner comes packaged in 5-gal polyethylene-lined steel drums with nondrip spouts. — *Alken-Murray Corp, 131 E 23rd St, New York, N.Y.*



50,000 kilowatt central station built for Southwestern Public Service Company.

Solving the paradox of power plant construction through Pritchard's GOOD FINANCIAL DESIGN

How much should you invest in power facilities? This question has a double-edged answer. If you aim for lowest plant cost, the result can be poor efficiency and high operating costs. On the other hand, building for the best heat rate can run costs so high that the completed plant may not earn a reasonable return on invested capital.

Building power plants that offer the best solution to this kind of problem is a Pritchard specialty. All of Pritchard's services—ranging from economic studies, engineering and construction, to delivery of a turn-key plant—are focused on good financial design that balances operating costs against capital investment. Examples of Pritchard's skill in striking this economic "balance" point can be found in many power installations over the country.

When you are confronted with the paradox of power plant construction, let Pritchard help you get the most advantageous solution. Pritchard is staffed to submit a turn-key proposal—or can supply design, engineering or construction services separately.

PROFITABLE FACILITIES THROUGH GOOD FINANCIAL DESIGN

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS

Dept. 411, 4625 Roanoke Parkway, Kansas City 12, Mo.

OFFICES IN CHICAGO, HOUSTON, PITTSBURGH, NEW YORK

SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

POWER POINTERS

257,500,000,000,000 BTUs

SINCE INSTALLING ONE OF THE COUNTRY'S FIRST HIGH PRESSURE FEEDWATER HEATER SYSTEMS, AN EASTERN POWER PLANT HAS CONVERTED OVER 10¼ MILLION TONS OF COAL INTO BTU'S. YET NOT A SINGLE MONEL TUBE IN ANY OF THE HEATERS HAS BEEN REPLACED. HEATERS OPERATE AT 2000 PSI WATER PRESSURE, USE STEAM AT 900° F. STRONG MONEL* NICKEL-COPPER ALLOY RESISTS CORROSION, PERMITS USE OF RELATIVELY THIN-WALLED TUBING FOR MAXIMUM HEAT EXCHANGE.

¼ billion flexures in chlorinated water

...Monel check valve springs still springy

IN 1932, 3,450 MONEL CHECK VALVE SPRINGS WERE INSTALLED IN A METROPOLITAN WATER PLANT'S FOUR LARGE PUMPS. PREVIOUSLY, STRESS-CORROSION BECAUSE OF CHLORINE IN THE WATER CAUSED CRACKING AND FAILURE OF SPRINGS, SHORTENED THEIR LIFE TO 3 YEARS OR LESS. TODAY, OVER 90% OF THE ORIGINAL MONEL SPRINGS ARE STILL IN SERVICE, MANY AFTER 25 YEARS AND OVER A QUARTER BILLION FLEXURES.

The metal that comes back from Davy Jones' locker

MONEL ALLOY TAGS CLIPPED TO PUPS' FLIPPERS COME BACK FROM THE DEEP TO TELL A TALE OF THE MIGRATIONS OF SEAL HERDS. THE U.S. FISH AND WILDLIFE SERVICE FINDS MONEL ALLOY RETAINS IDENTIFYING MARKS FOR AS LONG AS 12 YEARS DESPITE SALT-WATER CORROSION AND ABRASION FROM ROCKS AND SAND.

Slowed down by a metal problem?

A TALK WITH ENGINEERS FROM INCO'S MECHANICAL ENGINEERING SECTION MAY HELP YOU GET BACK ON SCHEDULE. JUST GET IN TOUCH WITH US AND OUTLINE THE DETAILS. AND FOR A USEFUL RUN-DOWN ON MONEL ALLOY, WRITE DEPARTMENT **PE** FOR 30-PAGE INCO BULLETIN, "ENGINEERING PROPERTIES OF MONEL AND 'R' MONEL ALLOYS".

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street — New York 5, N. Y.

INCO

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INCO NICKEL ALLOYS

ACTUAL SIZE

GET THE MOST FOR YOUR

BTU DOLLAR

...with Nicholson steam traps

You get top operating temperature per dollar of fuel consumption . . . when you use the Nicholson steam trap. This trap purges all air and non-condensibles from pipes and equipment *continuously* . . . not just at warm-up time. Your boiler doesn't have to operate at top capacity —all the time—to obtain top steam temperature where and when you need it.

Make full use of your BTU dollar, with Nicholson traps. They have only one moving part . . . a valve that operates on just a few degrees of temperature differential.

In your steam generation, and in your steam utilization . . . Nicholson traps will save you money. You can try one . . . without obligation! W. H. Nicholson and Company, 12 Oregon St., Wilkes-Barre, Pa. Sales and Engineering Offices in 98 principal cities.

NICHOLSON

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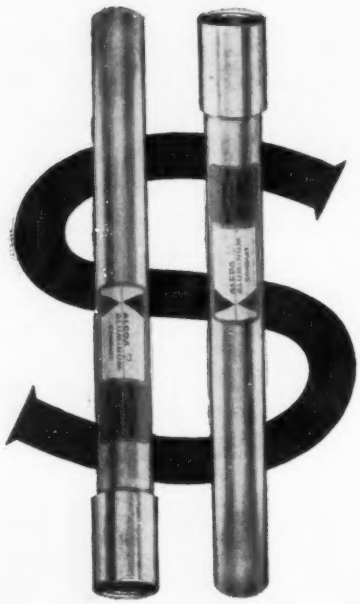
ALCOA ALUMINUM CONDUIT OFFERS NEW ECONOMY FOR ELECTRICAL DISTRIBUTION SYSTEMS. A growing number of consulting engineers, architects and contractors are recommending Alcoa® Aluminum Electrical Rigid Conduit as the ideal way to save electrical distribution dollars and to insure complete dependability. For distribution systems in office buildings, factories, refineries, processing and chemical plants and other new and remodeled structures, corrosion-resistant aluminum conduit has always offered a tremendous bonus in attractive appearance, longer life and maintenance-free operation. Now, lower prices in all sizes have made aluminum competitive with other materials. Aluminum conduit is easier to cut, bend and thread; it is nonstaining without painting; it is nonmagnetic and reduces voltage drop up to 20 per cent. It is nonsparking, lighter in weight and easier to install. It has the approval of Underwriters' Laboratories, Inc. Available for immediate delivery. For more information, contact your nearest Alcoa conduit distributor or Alcoa sales office. Aluminum Company of America, 2322-J Alcoa Building, Pittsburgh 19, Penna.

YOUR GUIDE TO THE BEST IN ALUMINUM VALUE

ALCOA ALUMINUM CONDUIT

Underwriters' Laboratories, Inc. INSPECTED RIGID CONDUIT ISSUE MU-28

"ALCOA THEATRE." EXCITING ADVENTURE. ALTERNATE MONDAY EVENINGS



if you specify or install hot water heating systems...

...THESE P-K CATALOGS BELONG ON YOUR DESK

Water-to-water or steam-to-water convertors . . . P-K makes both in a wide range of sizes. All are engineered for high heat transfer and low maintenance. All are in quantity production for quick delivery and are competitively priced.

These catalogs will give you much useful information about P-K Convertors. If you don't already have them, just mail the coupon at right. The Patterson-Kelley Co., Inc., 2509 Warren St., East Stroudsburg, Pennsylvania.

Patterson-Kelley Co., Inc.
2509 Warren St., East Stroudsburg, Penna.
Send me the literature checked:

- ☐ Catalog 303 – P-K Convertors for Hot Water Heating Systems
- ☐ Bulletin 6050 – P-K Forced Boiler Water Heat Exchangers

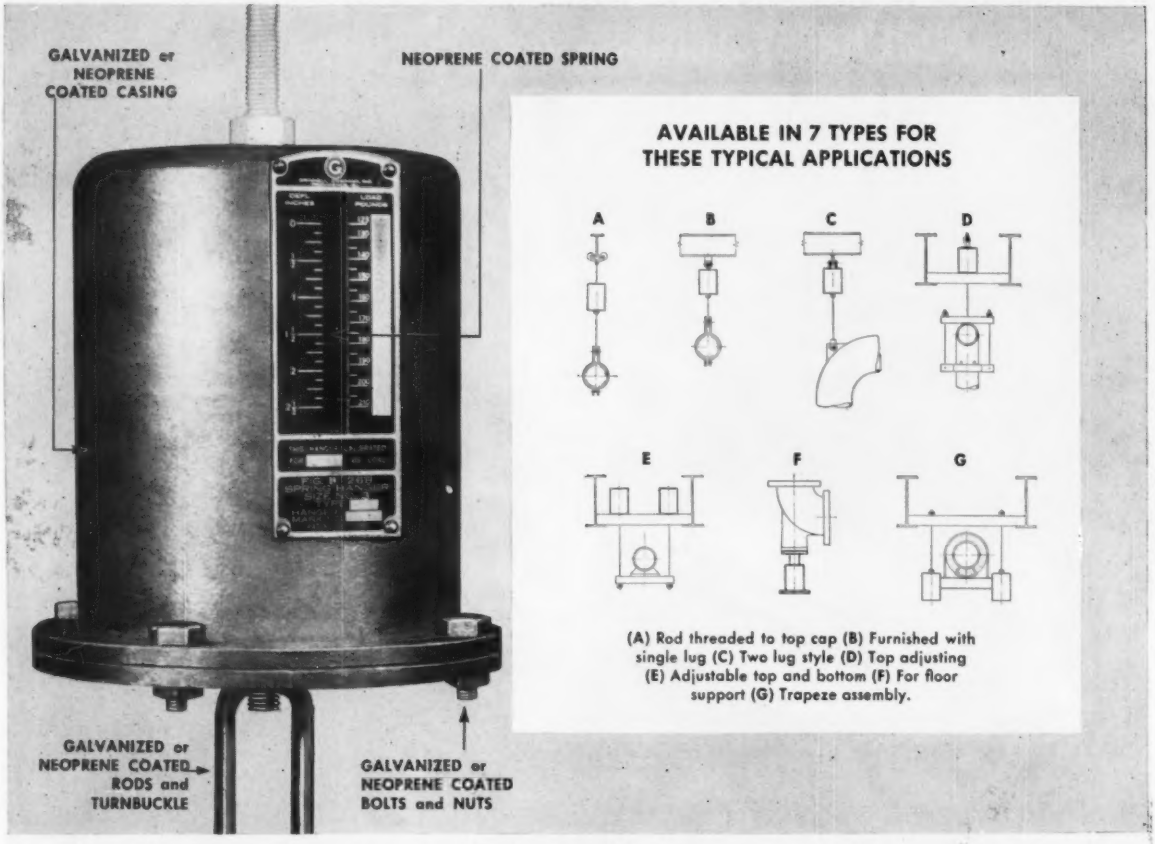
*Name*_____ *Title*_____
*Company*_____
*Address*_____
*City*_____ *Zone*____ *State*_____

Patterson Kelley
Water Heater Division

Storage Water Heaters • Instantaneous Heaters • Convertors • Fuel Oil Heaters

corrosion-resistant, weather-resistant

GRINNELL VARIABLE SPRING HANGERS


GALVANIZED or NEOPRENE COATED CASING
NEOPRENE COATED SPRING
GALVANIZED or NEOPRENE COATED RODS and TURNBUCKLE
GALVANIZED or NEOPRENE COATED BOLTS and NUTS
AVAILABLE IN 7 TYPES FOR THESE TYPICAL APPLICATIONS
A
B
C
D
E
F
G
(A) Rod threaded to top cap (B) Furnished with single lug (C) Two lug style (D) Top adjusting (E) Adjustable top and bottom (F) For floor support (G) Trapeze assembly.

In addition to their proven corrosion and weather resistance, these spring hangers offer other features.

- Maximum variation in supporting force for standard spring models per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression (a patented feature) assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- 21 sizes available from stock for load ranges from 50 lbs. to 28,200 lbs.
- Available in 3 spring lengths for maximum travel of 1¼, 2½, and 5 inches.
- Installation simplified by integral load scale and travel indicators.
- All-steel welded construction meets pressure piping code.

For hanger installations which are subject to highly corrosive industrial conditions — or where exposed to severe weather, Grinnell makes available two distinct lines of pre-engineered spring hangers.

These hangers are the result of extensive experimentation with various coatings for Grinnell's standard pre-engineered spring hangers. In addition to providing flexibility in pipe suspension, they provide versatility of application through their corrosion-resistant characteristics.

1. NEOPRENE COATED — for highly corrosive conditions, such as those found in chemical plants and refineries. All parts of the hanger are neoprene coated to protect the base metal from a wide range of corrosives. The flex life of the spring is unaffected by the neoprene . . . the coating resists cracking or flaking over a wide temperature range.

2. GALVANIZED — for outdoor installations, where weather conditions are severe. All parts of the hanger are galvanized except the spring, which is neoprene coated to avoid alterations of temper, hydrogen embrittlement and decreased flex-life of the spring — usual hazards to springs from the galvanizing process. Write for further details.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

How to get a "custom" pump at a standard price

Here's a new line of vertical centrifugal pumps easily tailored to your exact needs.

For process transfer or heavy-duty sump service, these pumps have features which assure long trouble free life with a minimum of maintenance.

Because they're built from standard parts, delivery is fast and there is no premium charge for custom building. When you want to change pit depth or pump ratings, you merely replace necessary parts. Units may be adapted in the field. Shafts and pipe columns are available for any pump length from 2 to 20 ft. in 6-inch increments.

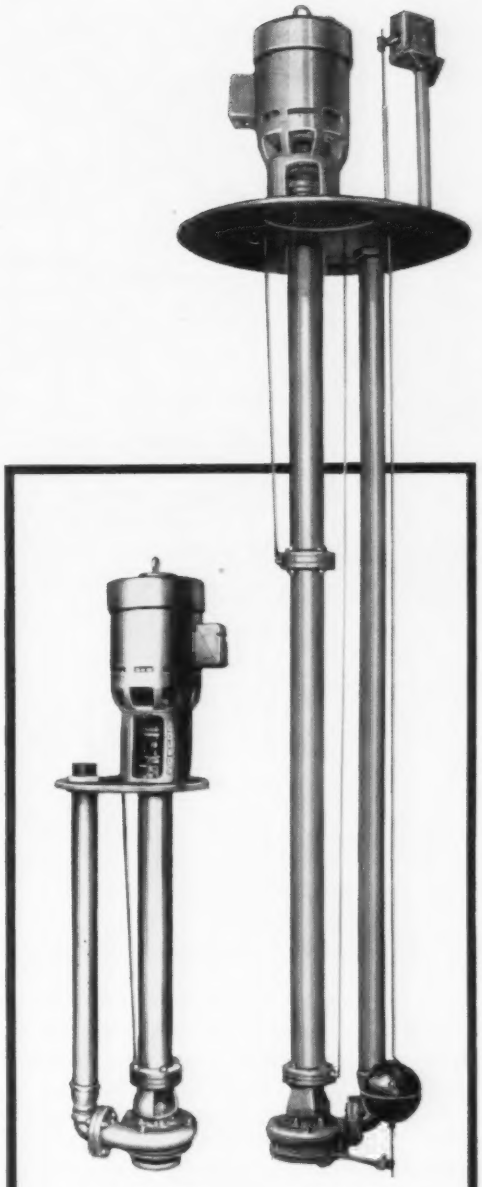
There are types for wet or dry pits, with capacities to 1080 GPM or heads to 290 ft. Vaporproof construction is available.

Complete details in Bulletin 726.2.

GOULD PUMPS, Inc., Dept. PO-98, Seneca Falls, N.Y.

Main Office and Works

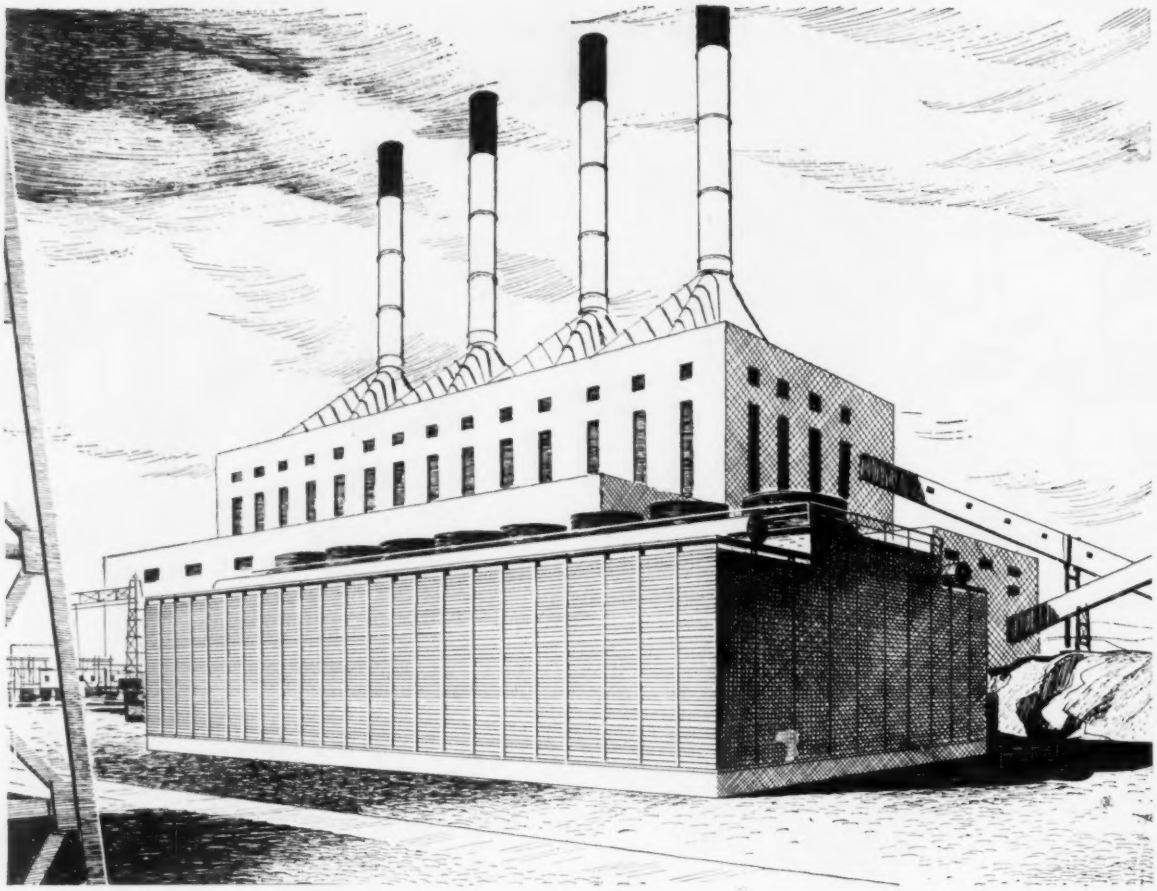
Branches and Representatives in all principal cities



Goulds Fig. 3173 Goulds Fig. 3171

GOULDS

PUMPS FOR INDUSTRY



CORROSION IS COSTLY

control it with CALGON®

Corrosion damage to cooling and service water systems is costly in more ways than one. When you count replacement costs of the system itself, and add to that the expense of delays and outages and even damage to high priced equipment, corrosion looms as a very large cost factor.

Systems *can* be protected against these needless costs. Calgon Engineering Service can provide the right answer to your particular problem. Water temperature and chemical makeup, the type of system, the metals exposed to water damage, these, and many other factors, determine the Calgon engineer's recommendations.

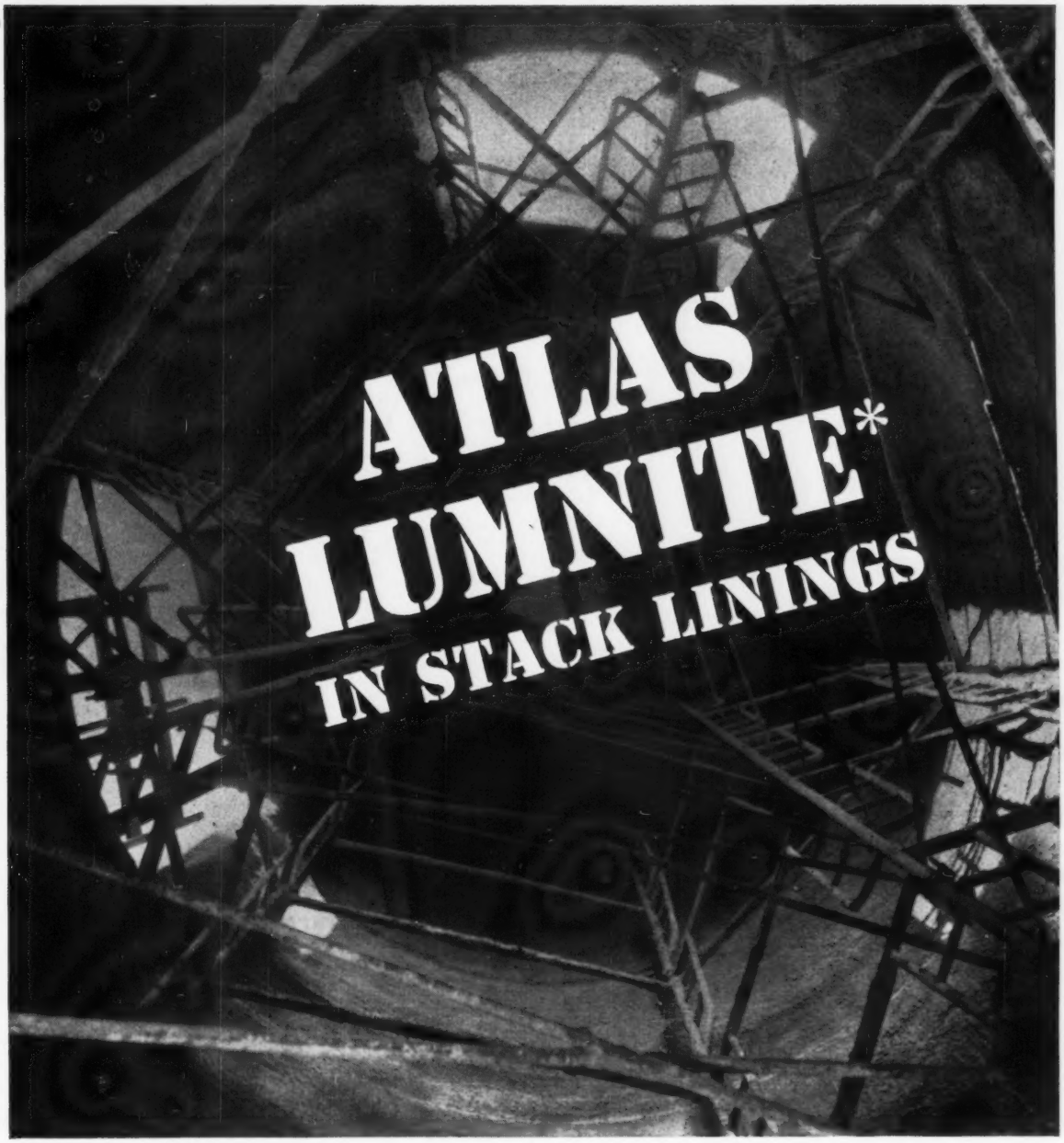
Calgon* is used to control destructive corrosion in tubing and heat exchangers, even at elevated temperatures. Provision is made for the control of organic growths and for the protection of cooling towers, as well. In each case, treatment is set up to protect the entire system.

Many years of experience with industrial water problems in all parts of the country is the reason why Calgon Engineering Service can provide reliable protection for your plant. A letter or phone call will put one of these experts to work for you.

*Calgon is the Registered Trademark of Calgon Company for its sodium phosphate glass (sodium hexametaphosphate) products. The use of polyphosphates for the prevention of corrosion is covered by U. S. Patent 2,337,856.

CALGON COMPANY

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO



Looking up a 200-ft. power-plant stack being lined with corrosion-resistant concrete made with LUMNITE cement. One of two stacks (Units 4 and 5) of Pacific Gas & Electric Company's Contra Costa Power Plant near Antioch, Calif. Gunite Contractor: Johnson Western Gunite Co., Gardena, Calif.

- Industrial concretes, made with LUMNITE calcium-aluminate cement and suitable aggregates, resist heat, corrosion, abrasion, thermal shock – and provide insulation.
- Placement is fast and easy – by guniting, pouring or plastering.
- Downtime is reduced to a minimum because concretes made with LUMNITE cement are ready for service in 24 hours.

For maximum convenience, use castables made with LUMNITE cement. These are packaged mixtures, ready for use. Just add water, mix and place. Made and distributed by leading manufacturers of refractories.

Write for a copy of the "Lumnite Mortar Manual," describing gun-applied linings:
Universal Atlas, 100 Park Avenue, New York 17, N.Y.

*ATLAS *and* LUMNITE *are registered trade-marks*

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Universal Atlas Cement
Division of United States Steel

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MEMO TO MEN
ON THE WAY UP

WHERE THERE'S BUSINESS ACTION THERE'S A BUSINESSPAPER

Used to be a song, back in the Thirties, titled, *Little Man, You've Had a Busy Day.* Didn't mention the Big Man. But his days are busy, too. He's the man who must make top-level decisions in business. And to make those decisions, he must have facts. All the facts. All the pertinent information he can get.

He finds time, in his busy days, to get that information. How? By getting a major portion of it from one unique source: the business publications serving his particular field.

No businessman, Little or Big, is fully informed until he reads his businesspaper. He reads it for profit, not for pleasure. He searches it through for news of the trade or industry. For facts. For fresh ideas. For new products he can put to work. And he reads the advertising with the same intense concentration he devotes to the editorial pages.

For the man on his way toward becoming a Big Man, his businesspaper is especially important. Take a tip from the reading habits of key men at every level. Take out a subscription of your own. Then, make the time to read every issue—and read it thoroughly.

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A McGraw-Hill Publication

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FOR PROCESS AND POWER INSTRUMENTATION

Guaranteed accuracy. Backed by 50 years gauge manufacturing experience. Many "standards" in stock.

Ranges from 15 p.s.i., or 30" of vacuum, to 20,000 p.s.i.

Bourdon tubes of bronze, drawn or bored s/s and other alloys

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The makers of dependable Kunkle Valves

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Specialists in
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POWER

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MECHANICAL ENGINEER—To $7,500

For plant engineering staff. Modification & design plant buildings & equipment plus responsibility operation large power units. National chemical co, Indianapolis location. Send detailed resume to

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Wanted—University graduate Engineer with at least five years experience operation steam electric generating station for responsible position in Maracaibo, Venezuela. Preference will be given Spanish speaking applicant. Salary dependent on qualifications. P-8319, Power.

Operation & Maintenance—U.S. Airbase (Canada). Central Heat & Power Plant; Steam Distribution. Engineers, Operators & Mechanics. Single Status. State salary requirements with resume. P-8346, Power.

Wanted—Experienced man as Chief Engineer in charge of College central heating plant and distribution system. Should be familiar with both coal and oil burning equipment. In reply state education, training, experience, age and current wages. If married state number of children. State where employed last five years. A good opportunity for steady work. P-8538, Power.

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Wanted: Manufacturer's representative to sell our line of high-quality molded long fiber asbestos-rubber gaskets both for original equipment and replacement sales. Need aggressive individual in Chicago, Illinois; Philadelphia, Pennsylvania; Cleveland, Ohio; St. Louis, Missouri; Los Angeles, California; Pittsburgh, Pennsylvania; Boston, Massachusetts; New York City, or Metropolitan Newark, New Jersey. RW 7957, Power.

Salesmen with active following of operating engineers in factories, institutions, S.R. & R.R. Repeat business. Constantly increasing income. Commission Plus. SW-8650, Power.

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Power Plant Engineer, age 35, 15 years experience. Nine years in large, modern steam-electric power plants. Six years extensive marine operating and maintenance experience. Licensed First Assistant Engineer U.S. Merchant Marine, any horsepower. Present job—Control Operator. Prefer Shift Supervisor, Maintenance Supervisor, or Assistant Superintendent. PW-8685, Power.

Power Plant Superintendent, age 36, technical education, 12 years experience in the operation, maintenance and plant betterment of turbo-electric power plants. PW-6856, Power.

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WANTED

Anything within reason that is wanted in the field served by Power can be quickly located through bringing to to the attention of thousands of men whose interest is assured because this is the business paper they read.

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Complete power plants, turbo generators, Boilers, Condensers, Engine generators, Processing Plants and equipment.

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Circuit Breakers—Electric Supplies
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for your new surplus motors, controls and transformers!
AVAILABLE: NEW MOTORS
Over 5,000 new motors in stock from 1/6HP to 200HP. Special low prices.

Write, wire or phone collect!
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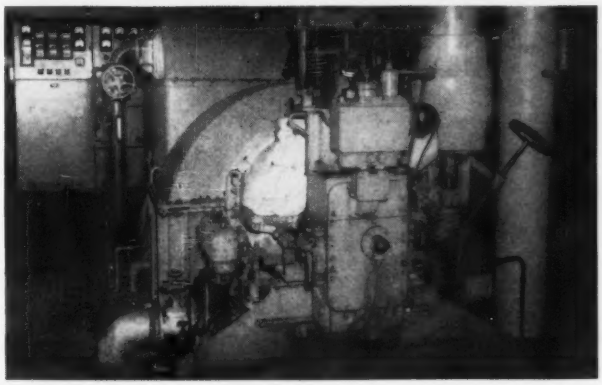

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IMMEDIATELY AVAILABLE

A COMPLETE LINE OF BOILERS AND DIESEL ENGINES ALSO IN STOCK
Any Additional Data Desired will be Cheerfully Furnished

CHARLES WEAVER, INC.

Cable Address: CHASWEAVER
19701 James Couzens Highway, Detroit 35, Michigan
Telephone: BRoadway 3-1900

GUARANTEED "REBUILT" POWER EQUIPMENT

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1750	*G.E.	K	3600
1750	*G.E.	K	1800
1250	*Al.-Ch.	ANX	3600
600	West.	CS	720
600	*G.E.	K-63455	1200
500	*G.E.	K-63455	1200
500	*G.E.	I-13-E	900
350	*G.E.	KT-559-A	1800
300	*G.E.	K6344	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-599-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-540	3600
200	West.	I-K-13B	1800
200	Brook	CSP-581-S	1800
200	*West.	RS-27	1200
200	G.E.	CS-930-A	900
200	*Al-Ch	KT-564-S	720
200	*West.	AN-37-G	720
200	Al-Ch	CS-1010	600
200	*G.E.	ARW-631	600
150	Cr-Wh	SC-140	3600

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
150	Al-Ch	AN-30-F	1200
150	West.	CSP-5815	1200
150	G.E.	I-K-15A	900
150	*West.	CS	600
125	Al-Ch	AR-226	1800
125	G.E.	5-Q	1200
125	Cr-Wh	K-558	900
100	W (TE)	CS-507-S	3600
100	G.E.	FT-542-Z	1800
100	Al-Ch (TE)	ARZ-826	1200
100	Al-Ch	AW-23-D	1200

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-575-S	1200

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1000	*West.	CW	450
600	*G.E.	M-6345-S	1800
500	G.E.	M-6345	1200
400	*G.E.	MTP-565	1200
350	*Al-Ch	ARYW	1800
300	Cr-Wh	SR70-R	1800
250	Al-Ch	ARY-626	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-16	600
200	*West.	CW1950A	514
150	Cr-Wh	SR-50R	1800
150	G.E.	I-M-15A	600
125	G.E.	I-M-15A	600
100	G.E.	I-E-13A	1800
100	G.E.	MT558	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200
75	G.E.	MT-347	1200
75	G.E.	MT-356	900
75	G.E.	MT-352	720
75	G.E.	I-M-10	600
60	G.E.	MT-356	1200
60	*West.	CW-762C	900
50	*G.E.	MT-536	1200

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CHICAGO Electric Co.

ALL TYPES OF EQUIPMENT IN STOCK

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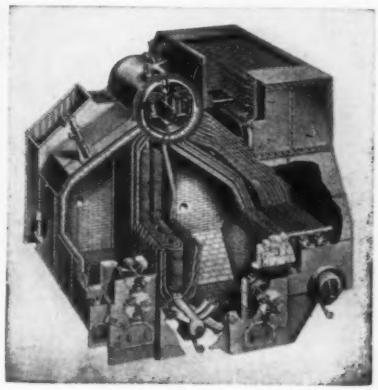

16 NEW UNASSEMBLED BOILERS.

B&W, Combustion Engineering, Foster Wheeler. Steel encased. 2 Drum Water Tube with Water Walls, Superheater, Economizer, Soot Blowers, Oil Burners. Complete.

# Steam/hr	PSIG	FTT
153,600	565	850
122,500	565	850
60,000	435	750
44,500	450	735
35,000	285	577

PRINTS and Photos available. Write **HEAT & POWER CO., INC., POWER EQUIPMENT DIVISION**, 60 East 42nd St., New York 17, N. Y.

BOILERS, PACKAGE TYPE

B&W, 1000 HP. designed for max. 400 lb. steam pressure. Oil fired.

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PRescott 8-6640

AUTOMATIC and MANUAL GAS or DIESEL GENERATOR UNITS
Complete Switchboard Design or Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

1500 HP D.C. MOTORS

1500 HP—525 volts D.C.—600 R.P.M.—NEW—2-bearing continuous duty motors—manufactured by Westinghouse. In original crates. From Navy Destroyer Escort. SPECIFICATIONS: 2-bearing 1500 HP—525 volts DC—2270 amps—600 RPM—ambient temperature 40C—class B insulation—2-bearing pedestal sleeve type—shunt wound—efficiency 94.23% ONLY 6 AVAILABLE—BUY NOW AND SAVE. Suitable for steel mill drive—offshore oil rigs—rolling mill drive—dredge pump applications.

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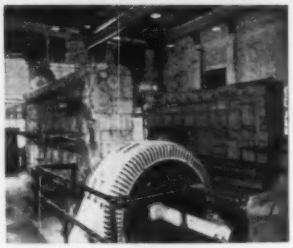
1480 KW FAIRBANKS MORSE—MODEL 33F16—Located Honolulu, T. H.

- New 1948
- Less than 15,000 hours total operation
- Will convert to dual fuel

1000 KW SUPERIOR—MODEL 80SX—Located Tavernier, Fla.



- New 1951
- Less than 15,000 hours operation since rebuild
- Will convert to dual fuel

Units Can Be Seen in Operation in Present Locations

• WRITE FOR DETAILED SPECIFICATIONS •

DIESEL ENGINES — POWER MACHINERY

100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.

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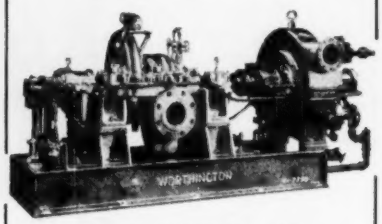
Turbine Driven

HIGH PRESSURE PUMPS

Chrome-Nickel Casing —
Cupro-Nickel Internals
Capacities to 700 GPM
Steam Pressure to 800 PSI
Discharge Pressure to 1000 PSI



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- Combination Cracking
- Evaporator Feed
- Fuel Oil
- Oil Refinery Charge
- Hydraulic
- Water Injection
- Hydraulic Descaling
- Thermal Reforming

12 AVAILABLE AT $4000.00 Each

Less than 50% of today's cost

Can be furnished with electric motor or will sell pump alone.

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MARITIME POWER CORP.

39 Broadway, New York 6, New York

HANOVER 2-3967

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	220/440	Whse.	720
125	2200	G.E.	600

AC GENERATORS or SYN. MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
200	2300/440	Whse.	G	1200
150	440/220	Whse.	G	1200
150	440/220	G.E.	TS	900
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2200/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
350	2300/440	G.E.	IE-K	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
200	2200	Cont.	TEFC	3600
200	440/220	G.E.	KT	720
200	2200/440	G.E.	IE-K	1200
150	440	Whse.	X-prf.	3600
150	2200	Al. Chal.	KT	720
150	440/220	G.E.	TEFC	720
150	2200/440	G.E.	AR	1800
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200
100	2300	Cont'l.	TEFC	3600
75(2)	440	Wagner	TEFC	1800

CIRCUIT BREAKERS, 3 Pole

1—6000 Amp., Whse., 600 V., Air, New
1—2000 Amp., R-Smith, 600 V., Air, New
4—1600 Amp., DA-50, Whse., 600 V., Air
6— 600 Amp., R. Smith, 7.5 KV, Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	600
60/75	230	G.E.	CD	500/1500

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Meter Type	Output V., DC
250	Whse.	440	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch., 2400/4160Y—600 volts, 3 ph.
3—333 kva, G.E., 13,800—2300 V.
3—333 kva, G.E., 2400-240/480 V.
3—250 kva, Al. Ch., 13,800—240/480 V.
1—200 kva, Al. Ch., 6900—220 V., 3 ph.
3—200 kva, Whse., 4600/2300—230/115 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, Al. Ch., 440-220 V., dry New
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E., 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

2—35 kva, 900 R, 220 V, 3 ph, conn, LeRoi, 6 cyl.
(1) 9.4 kva, 1200 rpm 120/240 V, 1 ph, Cont, 6 cyl.

only partial listing

STEPHEN HALL & CO.

HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

FOR SALE
14 NEW TURBINES

4 horizontal, 10 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired.

Price reasonable.

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. De ROSE
2457 WOODWARD AVE.
706 DONOVAN BLDG.
DETROIT 1, MICH.

FOR SALE

1 — 600 H.P. B & W horizontal water tube BOILER, 200 psi, ASME, 2 drum, oil fired. Completely instrumented.

2 — 200 K.W. and 1 — 240 K.W. Fairbanks Morse DIESEL ENGINE GENERATOR SETS, 240 volt, 247 RPM.

1 — 200 K.W. Worthington DIESEL ENGINE GENERATOR SET, 240 volt, 400 RPM. Available for immediate delivery

CAMDEN FORGE COMPANY

Box 269 Hoboken, N. J.

NY Telephone BArclay 7-0600

COAL PULVERIZERS

B & W type E, size 32, 75 HP motor.
RAYMOND #15 Super Mill, 66" dia., 6 roll, 200 HP.
PENNA. CRUSHER, Ring Granulator, 40 HP.

PERRY EQUIPMENT CORP.
1422 N. 6th St., POplar 3-3505, Phila. 22, Pa.

SAVE 50% or more . . .
On Transformers & Regulators!

NEW and USED surplus transformers and regulators available at considerable savings, 25 KVA to 10,000 KVA. Write for prices, giving specifications.

INDUSTRIAL ELECTRIC CO.
Box 661 Moultrie, Ga.

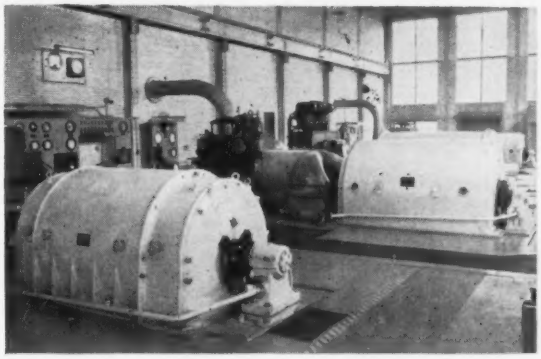
TRANSFORMERS

FOR SALE—Three 100 KVA General Electric continuous rated transformers, perfect operating condition, 4800 Volt Primary, 120-240-480 secondary. Also one Kuhlman 25 KVA lighting transformer 2400-4800 high and 120-240 low voltage.

SAGINAW FURNITURE SHOPS, INC.
666 Lake Shore Drive, Chicago, Illinois

SPECIAL OFFERING!

650 lb., 725 DEG TURBO GENERATORS — Still on Original Foundations As Shown in Photo Below — All Westinghouse, 3600 RPM, 80% P.F., 6900 V, 3/60.



1—9375 KVA, 7500 KW, 125 P.S.I.G. auto extraction, surface condenser, installed in 1937.
1—9375 KVA, 7500 KW, non-condensing, 125# B.P., installed 1930.
1—6250 KVA, 5000 KW, Condensing, with surface condenser, installed 1942.

•

BELYEA CO. INC.

43 HOWELL STREET **JERSEY CITY 6, N. J.**

N. J. Phone: OLdfield 3-3334
N. Y. City Phone: REctor 2-7150

HIGH PRESSURE STEAM BOILERS

***Government Surplus* SAVE OVER 75%**

NEW, NEVER USED, NEVER ERECTED, AVAILABLE IMMEDIATELY

121,650 Lbs.

1 Foster Wheeler
Express Type, 3-drum, with integral superheater separately fired.
Includes boiler, superheater, economizer, 7 fuel oil burners, soot blowers.
Pressure 634 psi, temp 850° F.
Furnace Vol: boiler 310 cu. ft., superh. 247 cu. ft.

60,000 Lbs.

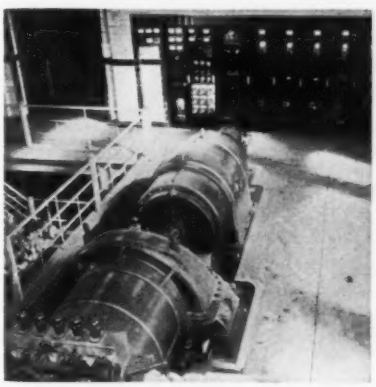
10 Babcock Wilcox
3 Foster Wheeler
"D" Type, 2-drum, with integral superheater fired between boiler tube bank.
Includes boiler, superheater, economizer, 3 fuel oil burners, soot blowers.
Pressure 435 psi, temp 750°F.
Furnace Vol: 330 Cu. Ft.

We own and stock these boilers. Inspection Invited at Utica, N.Y. Subject to prior sales.

Also on West Coast:
2—122,500# B & W's; 1—74,000# Header Type B & W; 1—60,000# Foster Wheeler

PELNIK-LOCONTI INDUSTRIAL SUPPLY CO.

Office Ph. Utica 6-4621 • 315 Oriskany St., Yorkville, N.Y. • Yard Ph. Utica 2-4513



1875 KVA POWER PLANT. STILL INSTALLED. Will be sold as complete unit or piece by piece. **TURBINE**—400 PSIG, 700°FTT with Surface Condenser and Pumps, direct connected to **GENERATOR** — 1875 KVA, .8PF, 3/60/2300/3600 RPM, complete with Controls. **BOILER**—25,000 #/hr, 450 PSIG, 738° FTT, Stoker Fired with Superheater, Fans, Feed Pumps. **AUXILIARIES**—Deaerating Heater, Coal Crusher, Elevator and Conveyors. **CRANE**—25 Ton, 36' Span. **PRINTS** and Photos available. Write **HEAT & POWER CO., INC., POWER EQUIPMENT DIVISION**, 60 E. 42nd St., New York 17, N. Y.

FOR SALE—EXCEPTIONAL BARGAINS

Diesel Generator Units, 200 KW-1500 KW — Turbo Generators, 500 KW-10,000 KW
Motor Generator Sets—Rotary Converters—Synchronous Condensers—
Frequency Changers—Transformers—Pumps, Boilers.

UTILITIES MACHINERY CORPORATION

1965 East Sixth St., Cleveland 14, Ohio • PHONES: CHerry 1-0210 & CH 1-4070

FOR SALE GENERATORS

One 200 K.W. and one 150 K.W., General Electric D.C. generators, 250 volts, 800 and 600 amp. driven by 20" x 24" and 18" x 24" Chuse steam engines (130 psi steam) complete with controls. Very good condition. May be seen in operation.

MALLINCKRODT CHEMICAL WORKS
3600 N. Second Street St. Louis 7, Mo.

BOILERS

HI-PRESSURE

Complete stock from 10-2,000 h.p.
Nation's largest inventory, New & Used

WABASH POWER EQUIPMENT CO.
9750 Skokie Blvd., Chicago (Skokie) Ill. OR 3-8118

CHECK WITH WAGNER FIRST!

Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P. OUR 52nd YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
700	Whse.	Slipring	2300/4000	1200
600	Elliott (2)	Sq. Cage	2300	900
500	Whse.	Slipring	2200	450
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	440	400
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
300	El. Machy (2)	Synch.	2200/440	720
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Slipring	2300	514
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Sq. Cage	2200	1800
250	Whse.	Sq. Cage	2300/440	600
225	G.E.	Synch.	220/440	900
200	L.A. TEFC	Sq. Cage	440	1200
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
175	G.E. (2)	Synch.	220/440	720
150	Rel. TEFC	Sq. Cage	220/440	900
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E. 2)	Sq. Cage	2200/440	1800
150	Whse.	Slipring	220/440	1200
125	G.E. T.E.F.C.	Sq. Cage	2200	3600
125	Ideal	Slipring	4000/2200	900
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. TEFC	Sq. Cage	220/440	900
100	Smith b.b. (6)	Sq. Cage	220/440	1800

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
125	Gen. Elec.	CD	250	1150
100	Reliance	651-T	600	1200
75	Gen. Elec.	CD-123	125/250	1200
60	Allis Ch. (3)	E-146	250	1500
60	Ideal	D	125	1150
25	Whse.	SK-103	250	1750

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
170	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
150	Whse.	SK-210	230	320/1000
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Whse. (4)	SK-163	230	500/1500
60	G.E. TEFC b.b.	CD-135	230	1150
50	Century	DN-514	230	1150/1750
50	G.E.	CD-125	230	400/1200
50	G.E.	RF-16	230	250/1000
50	Reliance b.b.	310-T	230	600/1800
40	G.E. (2)	CD-93	230	1750
40	Whse. b.b. (2)	SK-163	230	300/1200
25	Whse. 2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	G.E.	220/440 AC	600 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
75	Star b.b.	220/440 AC	250 DC
75	G.E.	200/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC

Arthur Wagner Co. Certified

MO nroe 6-7409

1435 W. RANDOLPH ST

CHICAGO 7, ILLINOIS

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	300	West.	Power Ctr.	3	2400/4160Y-240/480
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/3320Y/120/240
2	250	West.		1	2300/4600-230/460
1	225	Kuhlman	OISC	1	440-160 (Furn.)
3	200	G.E.	H	3	7800-15600-220/440
1	150	Eisler	OA	1	4160-240/480
3	100	G.E.	H		2400/4160-240/480
3	50	G.E.	HS	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
5	50	G.E.	HS	1	2400/4160-240/480
4	25	West.	Hypersil	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
3	60	E.M.	1200	125	220 v. Syn.
1	75	G.E.	1200	125	2300/4160 Syn.
2	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	300	G.E.	1200	250	440 Sync.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas EXD 62.5 KVA Westghe 3/60/480—1200

1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m. NEW.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
2	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M569Z	2300/4160Y

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	75	Cr. Wh.	860	WP 53 H
1	75	Star	1200	SB 60 L B.B.
1	350	G.E.	1200	Pedestal

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1800 RPM G.E. Type K 6336S 4150 V
1—275 HP, 1180 RPM G.E. Type KT 559BS 2200V
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300V
1—401P, 1750 RPM Wagner 444 440V T.E.F.C.
1—251P, 1170 Howell 405 440V T.E.F.C.

MOTORS—SYNCHRONOUS—3 phase, 60 cycle

125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
4100 HP 450 RPM Westinghouse Type HR 440 V.
1000 HP 360 RPM Westinghouse Ped. Type 2300 V.

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3277
PHONE NEW JERSEY—UNION 3-2600

13,750 KVA POWER PLANT. STILL INSTALLED. Will be sold as complete unit or piece by piece. Consists of (11) 1250 KVA Rathbun-Jones Natural Gas Generator Sets. **ENGINES**—1430 HP, 8 Cylinder, 4 Cycle, 300 RPM, direct connected to **GENERATORS**—1250 KVA, .8 PF, 3/60/2400-4160. Complete with Switchgear. Can be seen in operation on foundations. **PRINTS** and Photos available. Write **HEAT & POWER CO., INC., POWER EQUIPMENT DIVISION,** 60 E. 42nd St., New York 17, N. Y.

POWER EQUIPMENT

300 KW G.E. Non-C. Turbo Generator
3/60/480—150# 5-10#-BP 3600 RPM

1800 KW G.E. Cond. Turbo Generator
3/60/2400—410# 725°FTT

45000# Combustion Engineering BOILER
450# 750°TT oil fired

500 KVA 3 ph 60 cy 4150 V G.E. NEW STEP VOLTAGE REGULATOR

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

1902 COMPRESSORS 1958
WORLD'S BEST REBUILTS

100 CFM	125 psi	6x7 Ing.
116 CFM	50-150 psi	7x9 Pa. Booster
138 CFM	100 psi	7x7 Ing. ES-1
191 CFM	350 psi	9-4x9 Ing. ES-2
238 CFM	100 psi	9x9 Eng. ES
268 CFM	500 psi	10-4¼x10 Ing. or Worth.
465 CFM	100 psi	12x11 Ing.
502 CFM	125 psi	12x13 Worth. H.B.
585 CFM	100 psi	15-9¼x12 Ing. XRE 3-60-4160
590 CFM	100 psi	13½-8x8 Penn DE2 3-60-220
628 CFM	100 psi	14x13 Worth HB
676 CFM	100 psi	15-9¼x12 Ing. XRB—Worth.
870 CFM	125 psi	17-10½x12 Ing. XRE 3-60-220
1007 CFM	100 psi	19-11x12 Chic. OCB
1008 CFM	125 psi	16/10½x8½ Worth YC-2
1302 CFM	125 psi	20-12x14 Chic. OCE 225 H. P. 3-60-440 — 8 PF Aftercooler-Receiver

AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

375/250 KVA Steam: 125/250 KVA Gas Sets
3000/3500/5000 sq. ft. Surf. Condensers
60,000 lbs./hr. Deaerating Feed Wtr. Heater
75 HP Locomotive Type Boiler—150 lb.
10-20-30-350 HP Gas Fired Boilers
30 KW M. Gen. Exciter Set—1952
200 HP Package Type Boiler
100 & 75 HP Slow Speed Slip Rg. Mtrs.
H. & P., 6719 Etzel, St. Louis 14, Mo.

FOR SALE
POWER PLANT EQUIPMENT

Two used boiler blowoff tanks, size approximately 1,050 gals each, shipping wgt. 18,000 lbs. each. Purchased 1946 and 1948. Excellent condition. Write for full description.

One used Westinghouse 1,500 KW, serial #2588829, 600 rpm rotary converter, 13,800/6,600 volts, 3-phase a.c., 5,800 amps., 250 volts d.c. with 1,650 KVA Westinghouse transformer. Excellent condition. $9,000.00 "as is, where is", New Orleans, La.

NEW ORLEANS PUBLIC SERVICE INC.
(attention: Louis H. Moss, Purchasing Agent)
317 Baronne St., New Orleans 9, La.

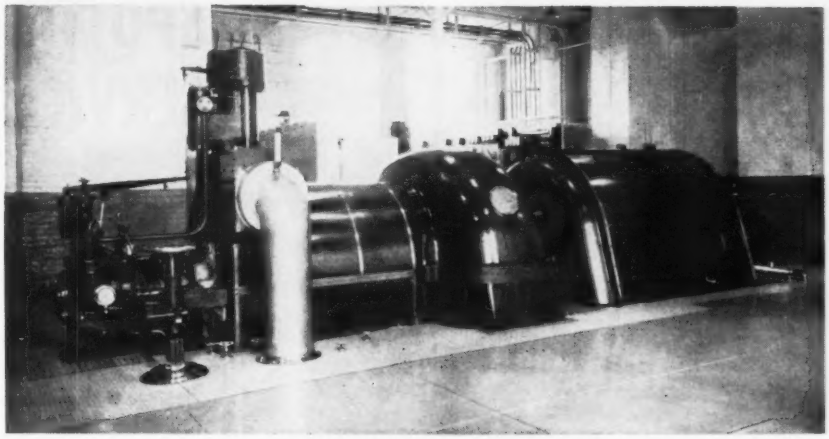
REAL BARGAIN DIESEL

New, unused Cooper-Bessemer type JS-6-D 6 cyl. 13" x 16" Diesel. Normally rated 705 HP @ 514 RPM. Current model. Will sacrifice. Contact

J. E. SMART, BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin. — Phone SO 2-0900

BARGAIN OFFERING

6250 KVA—5000 KW, 80% P.F. TURBINE GENERATOR
400 PSIG, 700°FTT 3 PHASE 60 CYCLE 2400/4160 VOLTS



(Actual Photograph Above)

5000 KW, 3600 RPM General Electric condensing turbine generator unit, complete installation with surface condenser, auxiliaries and direct connected exciter. Excellent condition.

UTILITIES MACHINERY CORPORATION

1965 EAST SIXTH STREET TELEPHONES: CH 1-0210 & CH 1-4070 CLEVELAND 14, OHIO

DIESEL GENERATOR SETS

1250 KW Cooper-Bessemer Dual Fuel, 1650 HP, 327 RPM, supercharged. Westinghouse 3/60/2300 generator with all accessories. New 1949.

400 KW General Motors Quad portable diesel generator. 650 HP. Skid mounted radiator cooled. Westinghouse 3/60/2300 generator, complete, used 60 days.

Both units in excellent condition. Priced attractively.

WHISLER EQUIPMENT COMPANY
611 Olive St. St. Louis 1, Mo.
CHestnut 1-4474

TRANSFORMERS

1—300 KVA, 3/60/4160-240 Wagner, ITE type HPE Unit Substation, Outdoor.
2—250 KVA, 1/60/2400-240/480 Moloney OISC, type YC, with taps
1—225 KVA 3/60/440-208Y/120, Moloney Dry
1—250 KVA, 4—150 KVA, and 2—100 KVA 1/60/4160-240/120 Whse. Inerteen with taps
1—200 KVA 3/60/4160-240 Wagner, ITE type RPB Unit Substation, Outdoor.
3—15 KVA, 1/60/240-480/120-240 Sorgel Dry

CASH
For Surplus Electrical Equipment
BENSON-WILIMZIG, INC.
1708 North 8th St., St. Louis 6, Mo.
Phone GArfield 1-4290

DIESEL ELECTRIC SET

New 110 KW—275 Volt DC Generator direct connected to new or rebuilt 6-71 GMC diesel. This unit always in stock for immediate delivery. Send for photo and specifications.

HICKORY EQUIPMENT, INC.
511 Hamilton Bldg., Knoxville 2, Tenn.

COMPLETE NEW 4600 KW TURBO POWER UNIT

4600 KW General Electric Generator, type ATB-2, complete with air cooler, 93-1/3 cycle, 3 phase, 2700 volt, 984 amps. 5600 RPM (output 2950 KW, 60 cycle, 3 phase, 1700 volts at 3600 RPM)

6180 HP General Electric Condensing Turbine, 410 PSI at 724 Deg. F., exhaust 28.5" HG, complete with throttle valve and 3800 square foot Foster Wheeler condenser with steel shell, cupro-nickel tubes and tube sheets, monel water boxes.

NEW MOTORS

New 1500 HP DC Motors—525 Volts, 600 RPM Westinghouse, in original crates.

New 6000 HP AC Motors—3 phase, 93 1/3 cycle, 2700 Volts 400 RPM reversible, General Electric, in original crates with controllers (can be used 3 phase 60 cycle 1700 volts 257 RPM, 3800 HP.)

NEW FEED WATER HEATERS Struthers Wells, 206 Square Feet of Surface, 6 Pass, Steel Shell, Brass Tubes and Tube Sheets, Bronze Heads.

NEW ELLIOTT FLUID DEAERATING HEATERS 246,500#/HR, 1000 Gallon Tank Capacity Monel Construction.

NEW CONDENSERS
ALL SIZES

EASTERN SCRAP & SALVAGE CORPORATION
65 Muirhead Avenue, Trenton 7, New Jersey

MISS POWER EQUIPMENT SAYS,

"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed New and Rebuilt Motors"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
400	West. S.S. Drip	CSP-881S	1800
400	West. S.S. Open	CS	900
350	A.C. S.S. Drip	ARWW-626	3600
300	G.E. S.S. Open	IK	1800
300	F.M. S.S. Open	H	1800
300	G.E. S.S. Open	IK	900
300	G.E. S.S. Open	IK	720
300	West. S.S. Open	CS-1002	600
250	G.E. S.S. Open	KT	1800
250	F.M. S.S. Open	H	1800
250	G.E. S.S. Open	2200 V IK-16	1200
250	G.E. S.S. Open	IK	1200
250	G.E. S.S. Open	IK	900
250	G.E. S.S. Open	IK	720
200	G.E. S.S. Drip	K-6325	1800
200	F.M. S.S. Open	H-207	1800
200	Cont. T.E.F.C. S.S.	NP-686C	1800
200	C.W. S.S. Drip.	SC-86A	1800
200	G.E. S.S. Open	IK-15	1200
200	G.E. S.S. Open	IK-15S	1200
200	G.E. S.S. Open	2200 V IK	1200
200	G.E. S.S. Open	IK	900
200	Eng. S.S. Open	P-125.5	720
150	Ideal S.S. Open.	New A-585	1200
150	G.E. S.S. Open	KT-558	900
150	G.E. TEFCSS	K-8328	3600
150	G.E. TEFCS XP	K	3600
150	G.E. TESS	K	1800
150	West. S.S.S. Open	CS-778C	1800
150	West. S.S. Open	2200 V CS	1800
150	G.E. S.S. Open	IK	1800
150	West.S.S.Open	CS-771C	1800
150	G.E. S.S. Open	KT	1200
150	Cont. T.E.F.C. S.S.	New	900
150	G.E. S.S. Open	IK	720
150	West.S.S.Open	CS-878A	720
125	G.E. S.S. Open	FT-543	3600
125	G.E. TEFCSS	K	3600
125	West. S.S.S. Open	New CS-607	1800
125	G.E. S.S. Drip	K-505	1800
125	G.E. S.S. Open	IK	1800
125	West. S.S.S. Open	CS	1800
125	A.C. S.S. Open	AR-505	1800
125	El. Dyn. S.S. Drip	KNX-222	1800
125	G.E. S.S. Open	KT-553	1200
125	G.E. S.S. Open	IK	1200
125	G.E. S.S. Open	IK	900
125	G.E. S.S. Open	IK	720
125	G.E. S.S. Open	IK	600
100	Howell TEFC. SS	KI505	3600
100	Wagner T.E.F.C.S.S.	CP-635	1200
100	West. S.S. Splash.	CS-754C	900
100	G.E. S.S. Open	KT-356	900
100	El. Dyn. T.E.F.C.S.S.	XP KNX-223	1800
100	G.E. S.S. Open	KT-343	1800
100	A.C. S.S. Open	2200 V ARX	1800
100	L.A. TEFC. SS	JX-113	1800
100	West. S.S.S. Splash	CS-770.3	1200
100	G.E. S.S. Open	K-504	1800
100	G.E. S.S. Open	KT-347	1200
100	West S.S. Open	2200V CS-774C	900
100	G.E. S.S. Open	IK	900
75	West. S.S. Drip.	CS-642C	1200
75	West. S.S. Splash.	440V CS-445	3600

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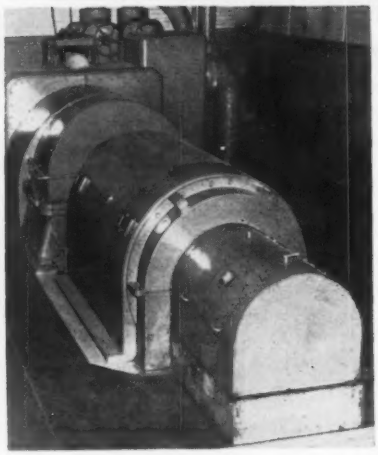

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23′	8″	Sch	30 — Gr P1
422′	3″	Sch	160 — Gr P2
51′	4″	Sch	120 — Gr P2
110′	6″	Sch	40 — Gr P2
67′	8″	Sch	40 — Gr P2
22′	10″	Sch	100 — Gr P2
20′	16″	Sch	100 — Gr P2
68′	2½″	Sch	40 — Gr P5
140′	2½″	Sch	80 — Gr P5
87′	3″	Sch	40 — Gr P5
200′	3″	Sch	80 — Gr P5
200′	4″	Sch	40 — Gr P5
160′	4″	Sch	80 — Gr P5
33′	6″	Sch	40 — Gr P5
25′	6″	Dble Ex Hy	— Gr P5
17′	6″	Sch	160 — Gr P5
110′	8″	Sch	40 — Gr P5
113′	8″	Sch	80 — Gr P5
12′	8″	Sch	160 — Gr P5
187′	10″	Sch	60 — Gr P5
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460′	3″	Sch	80 — Gr P11
340′	3″	Sch	160 — Gr P11
85′	4″	Sch	40 — Gr P11
600′	4″	Sch	80 — Gr P11
120′	4″	Sch	160 — Gr P11
47′	4″	Dble Ex Hy	— Gr P11
23′	6″	Sch	160 — Gr P11
70′	6″	Sch	40 — Gr P11
440′	6″	Sch	80 — Gr P11
1800′	6″	Sch	160 — Gr P11
50′	6″	Dble Ex Hy	— Gr P11
300′	8″	Sch	40 — Gr P11
1070′	8″	Sch	80 — Gr P11
1345′	8″	Sch	160 — Gr P11
41′	8″ x 1.264″ Nom. Wall		— Gr P11
25′	8″ x 1.25″ Nom. Wall		— Gr P11
1080′	10″	Sch	60 — Gr P11
1076′	10″	Sch	80 — Gr P11
28′	10″	Sch	120 — Gr P11
43′	10″	Sch	160 — Gr P11
53′	10″ x 1.563″ Nom. Wall		— Gr P11
95′	12″	Sch	80 — Gr P11
95′	12″	Sch	100 — Gr P11
24′	12″	Sch	120 — Gr P11
324′	14″	Sch	80 — Gr P11
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27′	6″	Sch	80 — Gr P12
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54′	10″ x 7/16″ Nom. Wall		— Gr P12
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46′	6″ x 1.10″ Nom. Wall		— Gr P22
330′	8″	Sch	80 — Gr P22
12′	8″ x 1.212″ Nom. Wall		— Gr P22

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Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	SF506S	4800/2400	1800
1	800	Whse.	CW	550	1776
1	700	Al. Ch.	D.P.	2300	500
1	600	Whse.	CW-432D-15	440	1778
1	500	G.E.	MT-412	2200	439
1	500	Whse.	CW	550	350
1	350	Cr. Wh.	SIZE-71SR	203/406	1763
1	350	G.E.	TM-17A	440/2200	720
1	350	Whse.	CW-1039C	440	720
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	350
1	250	A.C.		550	600
2	250	G.E.	MT-563Y	440	875
1	250	Whse.	CW-1010	2200	435
1	200	Whse.	CW-874D	220	885
1	200	G.E.	IE-13B	220	1760
1	200	G.E.	IM	2200	580
2	200	G.E.	IM	2200	435
2	200	Whse.	CW-890	2300	1775

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	500	G.E.	FT-559AY	2300	3600
1	550	Whse.	CS-1115	2300	900
1	500	Whse.	CS-1216	2200	500
3	500	G.E.	KF	2300	3600
2	450	Whse.	CS-1420	2300/4150	354
2	400	Whse.	CS-7151-610H	6600/4000	3565
1	400	G.E.	LK	2200	500
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-963H	2300	1175/878
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CS-8558	220/440	1750
1	150	G.E.	CS	440	530

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
1	3500	G.E.	TS-6438P	2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	660	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1000	G.E.	900	260	6600
2	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	500	Whse.	900	125/250	440
1	350	G.E.	900	125	440/2300/4160
2	300	G.E.	1200	250	2300
1	250	Whse.	1200	275	2300
1	200	El Mhy	1200	250	2300/4600
1	200	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	G.E.	1200	250	550/3300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300
1	100	G.E.	1200	250	4160/2400

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	7500	Whse.	650# condensing, 125# auto extraction, 6900 V.
1	5000	G.E.	400# surface condenser 2400/4150 volts.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x35/55
3	500	KUHL	OISC	1	13600x6600
1	225	Marcus	Air	3	auto208/220
3	100	G.E.	OISC	1	22900x2400/4160Y
3	100	Whse.	OISC	1	4600x460/230/115

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/880

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1—2250 HP Elliott 300 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 60 cy.
1—1375 H.P. G.E., MCF, 415 V. 1300 RPM D.C. motor with 1100 KW G.E. MG Set 415 V DC, 2300/4000 V. 720 RPM 3 ph. 60 cycle.
1—1200 HP G.E. MPC, 600 V. D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

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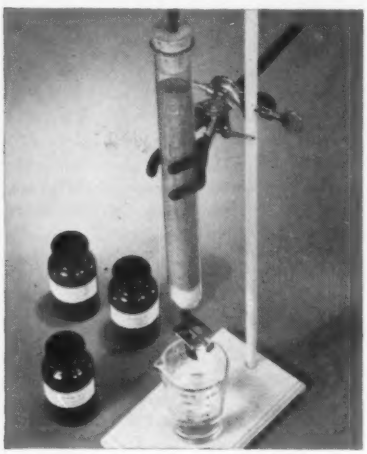
"Package" ion exchange equipment for lab or pilot plant . . . from stock

Laboratory ion exchange column

The Permutit laboratory or lecture-table kit includes a 1½″ O.D. glass tube with one end drawn down to fit ordinary laboratory rubber tubing, the ion exchange resin or resins required and literature describing ion exchange experiments. The user supplies the

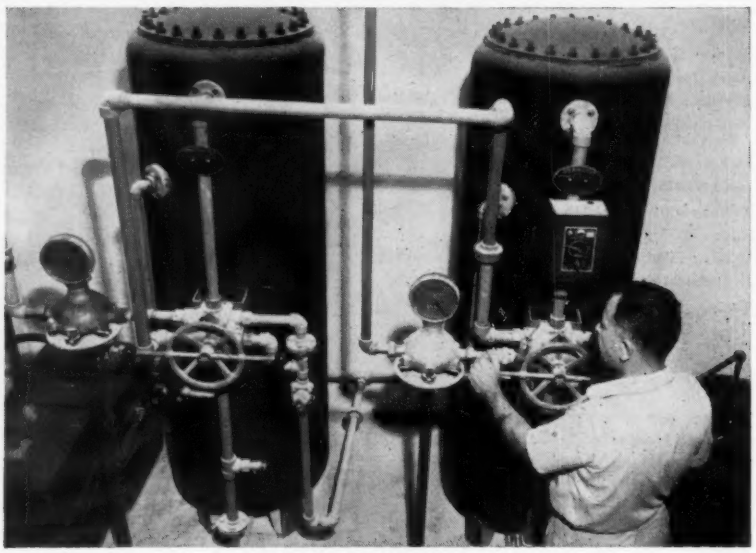


stand, clamps, tubing, stoppers and beakers. The tube will hold sufficient Permutit Q ion exchange resin to remove 20 to 25 grains of hardness.

This simple set-up is used for demonstrating ion exchange processes such as softening, dealkalizing or demineralizing water and for experiments in removal of impurities from process solutions and separation of metals from leached ores or waste liquids.

MBD-6A mixed bed demineralizer

The MBD-6A unit (6″ diam.) contains a mixture of Permutit Q cation exchange resin and Permutit S anion exchange resin. It will demineralize 1 to 2 gpm of water to a low total solids, low CO_2 and low silica content. Refills containing pre-mixed resin are available. Each refill has a capacity of approx. 1500 grains total electrolytes as $CaCO_3$. When the unit is exhausted, the fill may be discarded or regenerated and re-used.



A conductivity cell is mounted in the outlet line to be used with a conductivity meter for measuring the electrolyte content of the effluent and thus indicating when the resin bed is exhausted.

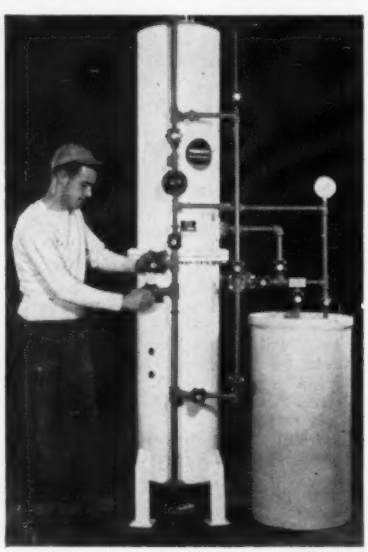
Standard equipment includes the MBD-6A with initial fill, faucet adapter and hose and conductivity cell. Optional equipment: conductivity meter, resin refills and an auxiliary tube for regenerating the resins.

MBD-15 mixed bed demineralizer

This compact unit will demineralize 6 to 7½ gpm of water to an average conductivity of 0.15 micromhos (approx. 6,000,000 ohms specific resistance per cm or 0.05 ppm total electrolyte content). CO_2 will be reduced to 0.1 ppm and SiO_2 to about 0.1 ppm.

Capacity of the MBD-15 between regenerations is approx. 20,000 grains total electrolytes. For example, it will demineralize 3420 gallons of water containing 100 ppm total electrolytes or 1710 gallons containing 200 ppm total electrolytes. When the unit is exhausted, the resin bed can readily be regenerated without removing the resins from the tank. The plastic regenerating tank is used for both regenerants.

The MBD-15 is supplied piped and partially assembled and requires connecting together only 3 flanges other than the connections to influent, effluent and waste lines.



16″, 24″ and 30″ diam. single bed units
(see photo above)

Diameter of unit	16″	24″	30″
Approx. flow rate (gpm)	10	20	30

Construction of these "package" units is of the same heavy-weight materials used for Permutit's large custom-designed units and includes rugged PVC plastic interior piping and plastic strainers, full 3/16″ thick rubber lining steam-cured and vulcanized to the heavy gauge steel shell. The entire lining is spark-tested at 25,000 volts. Exterior piping is high strength plastic.

Standard equipment includes a rubber-lined Permutit multiport control valve for each unit, acid pump, corrosion-proof plastic tank for cation regenerant and steel tank for anion regenerant. All parts are normally kept in stock for immediate shipment and are described in standard drawings.

• • •

For complete information, write to The Permutit Company, Dept. P-98, 50 West 44th St., New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

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This Tube is Precision Bored to Rifle Barrel Accuracy

Ashcroft Duragauge in Phenol case – a tough, rigid plastic turret type case for wall or flush mounting.

The Bourdon tube in Ashcroft Duragauges is machined mirror-smooth inside and finish ground outside to exact tolerances. Strong, uniformly thick walls assure precise flexibility–sustained high accuracy and long life.

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Order your Ashcroft Duragauges with the best Bourdon tube material for your service. Choose the all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. Full range of pressures, dial sizes, case designs and materials available. In any combination of components, Duragauges give sustained high accuracy and long service. Get details from your industrial supply distributor.

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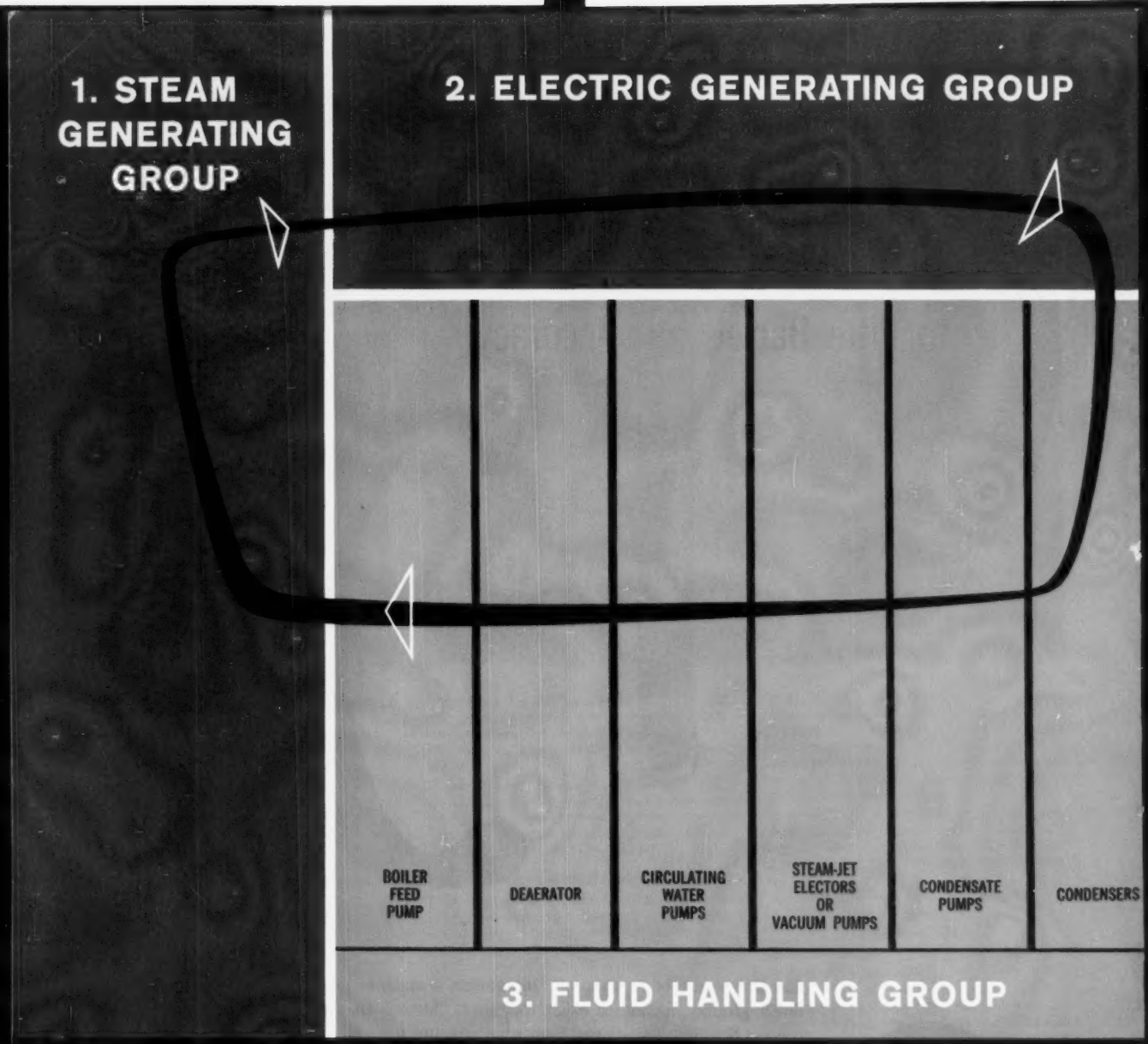

LOOK AT ALL THREE FOR POWER

THE FLUID HANDLING GROUP in a steam power plant has as many individual components as the other two combined. Failure of any one component can disrupt operation of the whole. Reliability can best be achieved through compatible integration of the wide range of equipment in this all-important group. As a manufacturer of all major fluid handling components, Worthington's "system-wise" experience and knowledge can be of extreme value to you. For information, write or call your nearest Worthington district office. Worthington Corporation, Harrison, New Jersey.

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